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ABSTRACT

This course of study is designed for the vocational agricultural student enrolled in an agricultural cooperative part-time training program in the area of milk processing occupations. The course consists of 11 units, each with 4 to 13 individual topics that milk processing plant employees should know. Subjects covered by the units are the following: the milk processing industry, nutritional properties of milk, microbiology and sanitation, milk quality and control, milk processing, by-products and specialties, plant equipment maintenance, electrical power and refrigeration, plant management, and plant maintenance. Each of the units includes an assignment sheet (which contains an objective, references, questions, and activities), and information sheets. Following the 11 units, answers are provided for the questions which appear earlier in the text. Additional materials include topic tests in true-false, matching, and other objective formats, and answers for these tests. (KC)

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MILK PROCESSING PLANT EMPLOYEE

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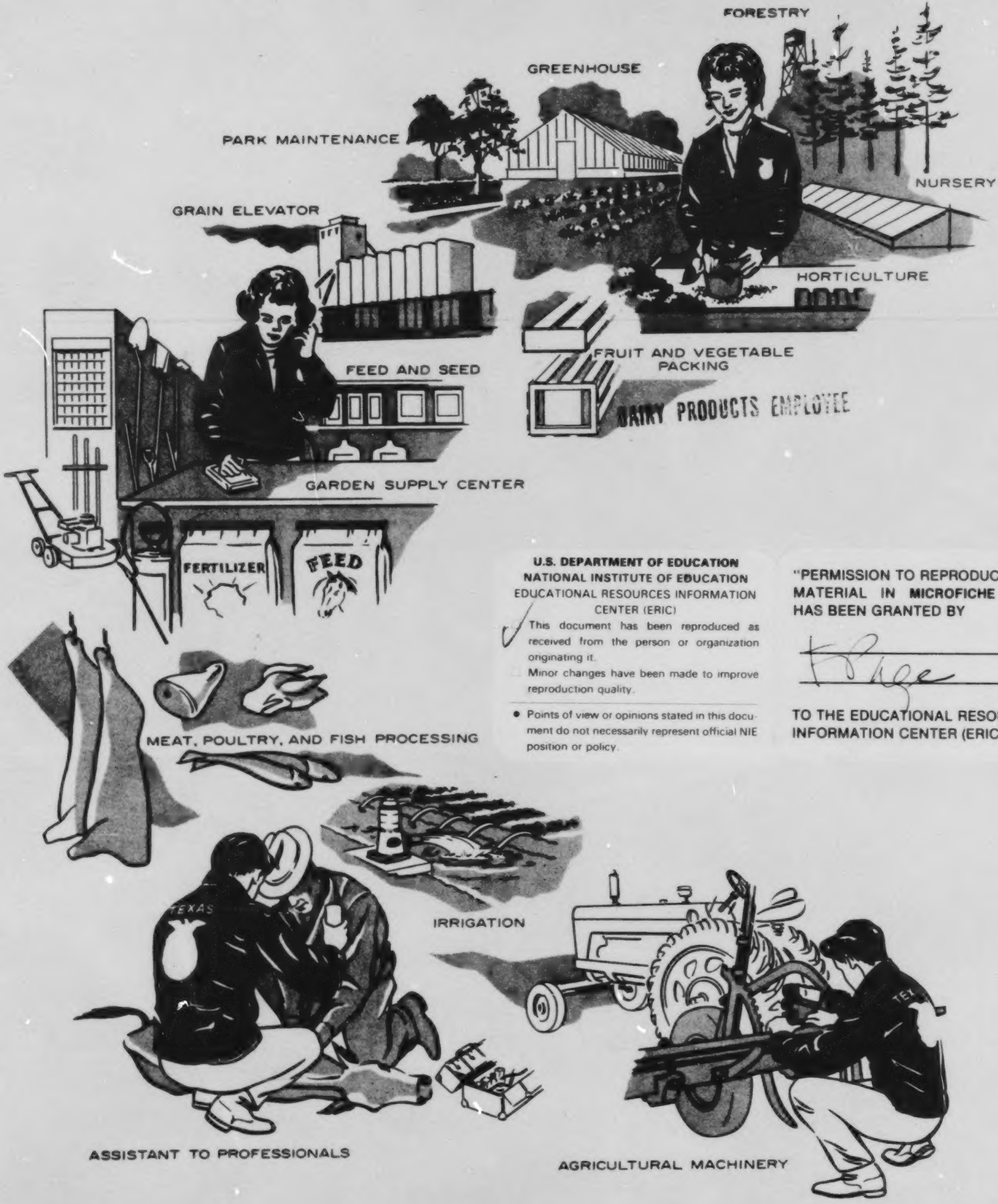
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IRRIGATION
TEXAS
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ACKNOWLEDGEMENT

State Advisory Committee for the Occupation of Milk Processing Plant Employee

Sincere appreciation is expressed for the time, interest, and help given in planning this course of study by the members of the State Advisory Committee. Pictured left to right are Emmett Koen, Foremost Dairies, Fort Worth; Paul Irwin, Gobles Dairyland, Wichita Falls; N.W. Lamb, The Borden Company, Houston; Dr. A.V. Moore, Professor (retired); and Dr. C.W. Dill, Associate Professor, Dairy Section, Animal Science Department, Texas A&M University.

This course of study is designed for the vocational agriculture student enrolled in the Agricultural Cooperative Part-Time Training Program. Nolan Blaschke, Vocational Agriculture Teacher, Columbus, Texas, and Foy Page, Subject Matter Specialist, Vocational Instructional Services Center, developed these materials for the Milk Processing Plant Employee.

Billy F. Irick, Subject Matter Specialist, Vocational Instructional Services Center, and Charles Urbanic, Vocational Agriculture Teacher, West Columbia, Texas, reviewed and edited materials for this course of study.

Foy Page, Coordinator
Vocational Instructional Services

Required References
for
MILK PROCESSING PLANT EMPLOYEE

Manual for Milk Plant Operators, Third Edition, Milk Industry Foundation, 910 Seventeenth Street, N.W., Washington, D.C., 1967. $11.75

COURSE OUTLINE FOR MILK PROCESSING PLANT EMPLOYEE

Unit I	Milk Processing Industry	1. Scope, Trends, and Opportunities 2. Job Training and Acceptance of Job Supervision 3. Plant Layouts 4. Accident Prevention and First Aid
Unit II	Nutritional Properties of Milk	1. Secretion, Composition, and Properties of Milk 2. Milk Fat 3. Milk Proteins 4. Milk Sugar 5. Minerals and Water in Milk 6. Vitamins in Milk
Unit III	Microbiology and Sanitation	1. Microbiology of Dairy Products 2. Milk and Diseases 3. Antibiotics, Pesticides, and Radioactivity 4. Housekeeping Principles 5. Cleaning and Caring for Equipment 6. Sanitizing Dairy Equipment 7. Cans and Can Washing 8. Bottle Washing 9. Insect and Rodent Control
Unit IV	Milk Quality and Control	1. Grades and Classes of Milk 2. Flavor and Physical Defects 3. Sampling 4. Bacteriological Tests 5. Butterfat Tests 6. Solids-Not-Fat Tests 7. Acidity Tests 8. Miscellaneous Tests 9. Standardizing Dairy Arithmetic 10. Grades of Cream
Unit V	Milk Processing	1. Equipment Layout 2. Materials for Dairy Equipment 3. Sanitary Pipe and Fittings 4. Sanitary Pumps 5. Receiving Equipment 6. Milk Tanks 7. Filters and Clarifiers 8. Separators and Homogenizers

Milk Processing Plant Employee
(Course Outline continued)

		9. Heating, Holding, & Cooling Equipment 10. Sanitary Thermometers and Gauges 11. Automatic Controls 12. Fillers and Sealers 13. Conveyors
Unit VI	Milk Processing	1. Receiving, Filtering, and Clarifying Milk 2. Common Pasteurization Methods 3. Other Methods of Pasteurization 4. Homogenization of Milk 5. Filling Containers 6. Milk Storage
Unit VII	By-Products and Specialties	1. Cultures-Fermented Milk Products 2. Skim and Buttermilk 3. Special Milks and Drinks 4. Cream 5. Concentrated Milk Products 6. Ice Cream and Related Products 7. Dry Milk Products 8. Butter and Margarine 9. Cheeses 10. Cheddar and Cottage Cheese 11. Process and Swiss Cheese 12. Other Varieties of Cheese
Unit VIII	Plant Equipment Maintenance	1. Uses of Steam and Hot Water 2. Hot Water Requirements 3. Boilers 4. Water Sources and Conservation 5. Water Impurities 6. Filters, Chlorination, and Corrosion 7. Corrective Water Treatments 8. Pumps and Piping 9. Air Compressors

Milk Processing Plant Employee
(Course Outline continued)

Unit IX	Electrical Power and Refrigeration	1. Terminology and Requirements 2. Wiring Materials and Controls 3. Electric Motors 4. "Sweet Water" and Brine Refrigeration Systems 5. Mechanical Refrigeration Systems 6. Maintenance of Refrigeration System
Unit X	Plant Management	1. Product Losses and Records 2. Operating Efficiencies and Production Schedules 3. Container Losses 4. Waste Prevention 5. Waste Disposal
Unit XI	Plant Maintenance	1. Painting 2. Floor, Roof, and Walls 3. Lighting, Ventilating, and Air Conditioning 4. Lubrication

Assignment Sheet
for
MILK PROCESSING PLANT EMPLOYEE

UNIT: Milk Processing Industry

TOPIC: Scope, Trends, and Opportunities

OBJECTIVE: To become familiar with the size of the dairy industry, current trends, and opportunities in the industry.

REFERENCES:
Required:
Information Sheet, "Scope, Trends, and Opportunities in the Milk Processing Industry"

QUESTIONS OR ACTIVITIES:

1. What is the most important single food during early childhood?
2. What other single food can substitute for milk in the diet?
3. Upon what does the use of milk in the human diet depend?
4. How many pounds of whole milk is consumed per capita in:
    a. Ireland
    b. Canada
    c. United Kingdom
    d. United States
5. How many pounds of butter is consumed per capita in:
    a. New Zealand
    b. United Kingdom
    c. Canada
    d. United States
6. What kinds of animal milk other than cow's milk are used for human consumption?
7. How many pounds of milk were used for coffee creaming in the United States in 1960?
8. Is raw milk equivalent to pasteurized milk?
9. Why is milk pasteurized?
10. What place does the dairy industry rank in the United States?
11. How many dairy cattle were in the United States in 1963?

Information Sheet
on
SCOPE, TRENDS AND OPPORTUNITIES IN THE MILK PROCESSING INDUSTRY

Milk and honey are two articles of diet that function solely as food.

"Milk is the most nearly perfect food" is a common expression used today.

Milk is consumed in one form or another throughout our lives as well as being considered the most important food during early childhood.

In the study of nutrition, milk has always served as the basic foundation. Up to the present time there has been no other single food substance that can completely be substituted for milk.

The availability as well as the economic and cultural attitudes of people are factors which determine the use of milk in the diet.

In 1960, the United States per capita consumption of whole milk was 653 pounds, and it ranked 15th in comparison to other countries. Ireland ranked 1st with 1,448 pounds, New Zealand was 2nd with 1,322 pounds, Canada ranked 8th with 894 pounds, and the United Kingdom ranked 11th with 835 pounds per capita consumption.

The United States also ranked 15th with 7.9 pounds of butter per capita consumption in 1959. First was New Zealand consuming 43.4 pounds, Ireland ranked 2nd with 42.5 pounds, United Kingdom ranked 8th with 18.8 pounds, and Canada ranked 9th with 18.2 pounds butter consumed per person.

The type of animal milk and its products are determined by regional and climatic influences. Cow's milk is used in Europe, North America, Australia, and New Zealand. Sheep and goats provide milk used by southern Europe. Reindeer milk is consumed by the people living in northern Europe, and water buffalo milk is used in southeast Asia.

63% of the people that consume 377 million cups of coffee daily in the United States use a creaming agent in their coffee. Therefore, a considerable quantity of milk is used in coffee. 11.3 billion pounds of milk or 9.1% of the total milk production was consumed in 1960 as a creaming agent.

That raw milk and pasteurized milk are equivalent in food value is a proven fact. However, some people believe that raw milk is better because that is the condition in which the young mammal consumes its mother's milk. Pasteurization kills pathogenic (disease causing) organisms that are frequently found in raw milk.

Scope, Trends and Opportunities in the Milk Processing Industry
(Information Sheet continued)

In order, the iron and steel, meat, automobile, and dairy industry are the four top industries according to wealth and income figures for the United States listed by the United States Department of the Interior.

Each dairy cow in the United States produced an average of 7,545 pounds of milk in 1963. There were 18,679,000 dairy cows on farms in the United States, and 124.783 million pounds of milk were produced.

Assignment Sheet
for
MILK PROCESSING PLANT EMPLOYEE

UNIT: Milk Processing Industry

TOPIC: Job Training and Acceptance of Job Supervision

OBJECTIVE: To become familiar with the procedures in training the plant employee.

REFERENCES:
Required:
Information Sheet, "Job Training and Acceptance of Job Supervision"

QUESTIONS OR ACTIVITIES:

1. What are the initial steps taken to train new plant employees?
2. What are some tips for management teams to follow when training new plant employees?
3. What are the two types of instruction in in-plant training programs?

Information Sheet
on
JOB TRAINING AND ACCEPTANCE OF JOB SUPERVISION

What Initial Training Covers

Initial training on the job should cover all those aspects of the job necessary for its successful accomplishment. It is apparent, therefore, that the content of the program will depend on what the job is. Its scope will depend on what the company puts into it and what it expects to get from it.

Steps in Initial Training

1. Explain the nature of the job, find out what the employee already knows about it, put him in a correct learning position, and build up his interest.
2. Tell the new employee why he is performing the job as he does. Example - "When dumping milk, be sure to smell it in the can. We don't want off- flavor or off odor milk in our plant, for it could affect all the milk and lose customers for us."
3. Explain the job to the new employee. List in order of performance exactly how he is to do each part of his job.
4. Let the new employee explain the job to you. Then you can tell if he truly understands what he needs to do.
5. Let the new employee see how the job is performed by other employees.
6. Let the new employee try the job himself. Let him make his own mistakes and then explain why each is wrong, and how he can correct his mistakes.
7. Motivate him continually in order to improve his efficiency.
8. Follow up as often as necessary to see that the job is being performed as it should be.

Tips and Techniques for Initial Training of the Employee by the Management Team

1. Create a desire to learn
2. Make safety a habit
3. Let the employee develop know-how on the job
4. Encourage the development of accuracy in performing work
5. Develop and encourage patience in the employee
6. Assist the employee in being at ease and free from tension.
7. Set goals for the employees
8. Don't confuse the new employee with too many bosses.
9. Don't attempt to train too slow or too fast.
10. Build confidence in the employee and make him feel part of the team.

Job Training and Acceptance of Job Supervision
(Information Sheet continued)

In-Plant Training Program

There should be regular training programs set up in the modern dairy plant where individual and group instruction should be held to keep employees acquainted with new developments and techniques in the processing of milk.

Assignment Sheet
for
MILK PROCESSING PLANT EMPLOYEE

UNIT: Milk Processing Industry

TOPIC: Plant Layouts

OBJECTIVE: To become familiar with the principles of plant layout for efficient operation.

REFERENCES:
Required:
Manual for Milk Plant Operations, Milk Industry Foundation, pp. 3-13

QUESTIONS OR ACTIVITIES:

1. What are the things to consider in changing, enlarging, or constructing a new plant?
2. How is the plant's functional ability determined?
3. How should facilities be designed to provide for future expansion?
4. What determines the flexibility of plant design?
5. What is the general direction of product flow in the milk plant?
6. Diagram, label, and indicate the product flow line in the plant where you work.

Assignment Sheet
for
MILK PROCESSING PLANT EMPLOYEE

UNIT: Milk Processing Industry

TOPIC: Accident Prevention and First Aid

OBJECTIVE: To learn common principles of accident prevention and simple first aid practices

REFERENCES:

Required:

Manual For Milk Plant Operators, Milk Industry Foundation, pp. 857-873

QUESTIONS OR ACTIVITIES.

1. What are some sound reasons for preventing accidents?
2. What does accident prevention mean?
3. Why should accident records be a part of the safety program?
4. What are some accident prevention steps to be taken by the milk plant?

Assignment Sheet
for
MILK PROCESSING PLANT EMPLOYEE

UNIT: Nutritional Properties of Milk

TOPIC: Secretion, Composition, and Properties of Milk

OBJECTIVE: To learn the principles of milk secretion and the components and properties of milk as they affect the milk processor.

REFERENCES:

Required:

1. Manual for Milk Plant Operators, Milk Industry Foundation, P. 488
2. Information Sheet, "Secretion, Composition, and Properties of Milk"

QUESTIONS OR ACTIVITIES:

1. List four reasons for acquiring knowledge of the components of milk and their properties.
2. What is the legal definition of milk?
3. Where and when is milk secreted?
4. How does frequent milking affect milk production?
5. List the average composition of milk from cows.
6. What are six factors that affect the composition of milk?
7. Name five factors that affect the color of milk.
8. Why is milk from Guernsey and Jersey cows more yellow than that from other breeds?
9. How many calories will one pint of milk of average composition furnish?
10. How many pounds of 3.5% milk are needed to prepare one pound of butter?

Information Sheet
on
SECRETION, COMPOSITION, AND PROPERTIES OF MILK

The quarter, one of four distinctly separate glands of the cow's udder, is composed of a teat, the hollow, and the teat cistern.

The teat cistern is connected to the gland cistern, which has a capacity that may vary from less than one pint to approximately one quart. Tubes or ducts branch out or divide innumerable times from the walls of the cistern.

The enlargements at the end of the duct system are called the alveoli. Most of the milk secretion takes place in the alveoli, but secretion occurs in the lining of the ducts, where milk is being secreted between milking periods. Milk accumulated in the alveoli produces a pressure which in turn reduces or stops its secretion. Pressure on the alveoli is reduced by milking; therefore, frequent milking increases milk production.

At the time of milking the pituitary gland of the cow receives a message through the sensory nerves to eject or let her milk down. This message, a reflex or involuntary action, is triggered by external means such as the calf sucking or by the milker washing and manipulating the udder. Upon receiving the message the pituitary gland releases two hormones--prolactin and oxytocin. Prolactin promotes growth of the udder and milk production. Oxytocin activates the alveoli to release milk into the ducts and then into the cisterns and teats.

Although milk is derived from blood, its composition differs greatly. A tremendous amount of blood must pass through the udder to produce milk. It has been estimated that 400 pounds of blood passes through the udder to produce one pound of milk.

Although milk contains all essential substances for human nutrition, some of the nutrients are not present in sufficient amounts or proportions to meet all human requirements beyond the suckling stage. This is especially true of some of the minerals and vitamins.

There is a great difference in the composition of milk of different animals. The development of the young at the time of birth seems to be related to the composition of milk. Young animals which are practically helpless at birth, such as pigs, dogs, cats, and rabbits, need more body-building nutrients--protein and minerals. The young which are better able to take care of themselves shortly after birth, such as calves, goats, and lambs, need more energy-type nutrients like fats and carbohydrates.

Due to the amount of water present in milk it is considered low in energy value compared to other foods.

Secretion, Composition, and Properties of Milk
(Information Sheet continued)

Factors affecting milk composition:

1. Breed of Cow - The breed of cow not only influences the color of milk but has a marked effect upon the fat content of the milk. The breeds of dairy cows that produce the highest fat content milk are the Jersey and Guernsey, whereas the breeds that produce the lowest fat content of milk are the Brown Swiss and Holstein breeds.

2. Time of Milking - The time of milking has an effect upon the fat content of milk. The noon milking has the highest fat content if a cow is milked three times a day. If the length of milking is equally spaced on two milkings a day, there is no difference between the fat content of the milkings. If a cow is milked late in the evening, the milk obtained in the morning may contain from 0.5 to 2.0% more fat. The interval of milking has little effect upon the amounts of protein and lactose in the milk.

3. Seasonal Variation - The fat content of milk is affected by seasonal variation. The fat content of milk is higher during the winter months than it is during summer or the hotter months.

4. Age of Cow - Although the fat content of milk decreases only slightly over a number of years the age of a cow has some effect on this.

5. Health of Cow - Salt and fat content of milk are increased and lactose content is diminished in the milk of a diseased cow. The albumin content is increased and the composition of milk tends to approach blood-serum in milk that is taken from a diseased udder.

6. Feed - The amount and kind of feed consumed by the cow affects both the composition and yield of milk. Underfeeding has a marked effect on the normal flow of milk, while overfeeding does not increase the amount of milk produced by the cow. Underfeeding will decrease the quantity of milk produced, and will cause a rise in fat content.

If feed is deficient in protein and carbohydrate content, there will be little effect on the composition of milk; however, the quantity of milk will be lowered.

It is not practical to increase the fat content of milk by feeding fat-rich foods. The fat content of milk will decrease if feed contains fish oils, such as menhaden or codliver oil.

Secretion, Composition, and Properties of Milk
(Information Sheet continued)

Temporary increases in fat production may be attained by feeding compounds such as thyroprotein or iodated casein. Feeding of these compounds for a long period of time will cause changes in the animal's metabolism. This is dangerous for cows in advanced gestation or during warm weather.

The percent of mineral content in milk stays fairly constant and is affected little by the feed. If the mineral content of feed is low the cow will draw upon her own skeleton to furnish these minerals.

The color of milk is affected by:

1. amount of fat
2. solids (other than fats)
3. size of the fat globules
4. breed of cow
5. feed of cow

The pigments carotene and riboflavin impart a yellowish color to milk. Jersey and Guernsey cows transfer more carotene and fat than other breeds do and produce milk that is more deeply colored.

If the fat content of milk is no higher than 3.66%, about 323 calories will be furnished from one pint of milk.

2.5 pounds of 3.5% fat milk is required to produce one pound of evaporated milk, whereas 23 pounds of milk is required to produce one pound of butter.

Assignment Sheet
for
MILK PROCESSING PLANT EMPLOYEE

UNIT: Nutritional Properties of Milk

TOPIC: Milk Fat

OBJECTIVE: To learn the characteristics and the importance of milk fat in nutrition.

REFERENCES:
Required:
Information Sheet, "Milk Fat"

QUESTIONS OR ACTIVITIES:

1. Distinguish between fats and oils.
2. The term "globules" refers to what?
3. How does mechanical agitation affect the fat globules?
4. What causes the rancid flavor and odor in milk products?
5. What are other compounds associated with milk fat?
6. Compare the digestion and absorption of milk fat with other common edible fats.
7. What types of foods contain saturated fats?
8. What are sources of unsaturated fats?

Information Sheet
on
MILK FAT

Fats and oils are widespread in nature and occur in almost all plant and animal matter. Although fats and oils are very nearly the same thing, fats are ordinarily solids at room temperature while oils are in a liquid state. The term butterfat is often used incorrectly in reference to milk fat. True butterfat, that fat obtained from butter, differs in composition from the fat obtained from whole milk.

The term lipid may be used for fats as well as for the fat-like substances lecithin and cholesterol. Milk fat and the fat-like substances are contained in milk in tiny droplets called globules. There are about 1500 billion of these globules in a pint of milk, which means they are smaller than some bacteria. The globules vary in size from one-tenth to 20 microns in diameter (a micron is 1/25,000 of an inch). They are usually of the larger size in milk that is exceptionally high in fat content, such as milk from Jerseys and Guernseys. In all dairy cattle there is a tendency for the globules to decrease in size toward the end of the lactation period.

Milk fat globules are inclosed in a thin membrane which keeps them from combining with other globules to form a mass of fat. When milk is churned, the agitation of the globules causes the membrane to break and form a mass of butter.

Milk is made up of about 12.5 percent glycerol and about 85.5 percent fatty acids by weight. Fatty acids are contained in all fats and oils and they are either saturated or unsaturated. Saturated fats are contained in meat fat, egg fat and of course milk fat. Unsaturated fats are found in vegetables such as cottonseed, soy beans, and corn. Butyric acid is saturated and is found in no natural food product other than milk. It, along with other fatty acids, has a strong odor and when milk fat decomposes or sours, this odor is released. This odor release causes rancid flavor and smell in milk and milk products.

Along with the fatty acids, milk fat contains, in small varying amounts the following:

1. Phosphatides - These compounds are made up of fatty acids combined with phosphoric acid and chlorine.

2. Lecithin - This is the best known phospholipide and the principal one found in milk. When butter is made most of the phospholipides end up in the butterfat. It is thought by many people that these compounds give buttermilk its good flavor. When phospholipides come in contact with the air for long periods of time they oxidize and cause "cardboard" or "cappy" flavor in milk.

Other minor components of milk fat are sterols (cholesterol), tocopherol (vitamin E), carotenoids, and vitamins A and D.

Milk Fat
(Information Sheet continued)

Milk fat is more easily digested than other common edible fats and more of it can be absorbed without creating a digestive disturbance. When milk coagulates in the stomach, fat globules are contained within the curd. This stops the formation of large masses of fat that would be difficult to digest. Milk fats along with other edible fats of low melting points have about the same degree of digestibility. Mutton fat has a high melting point and is therefore lower in digestibility.

Assignment Sheet
for
MILK PROCESSING PLANT EMPLOYEE

UNIT: Nutritional Properties of Milk

TOPIC: Milk Proteins

OBJECTIVE: To learn the characteristics and importance of milk proteins in nutrition and how they affect the milk processor.

REFERENCES:
Required:
Information Sheet, "Milk Proteins"

QUESTIONS OR ACTIVITIES:

1. From what was the word "protein" derived?
2. What are considered to be the "building blocks" of proteins?
3. How many amino acids are considered indispensable to nutrition?
4. On what is the nutritional value of proteins based?
5. What is the principal protein of milk?
6. How may casein be precipitated or coagulated?
7. From what is casein manufactured commercially?
8. How much casein will 100 pounds of skim milk yield?
9. List the uses of casein.
10. After the fat and casein are removed from milk, the resulting liquid is called what?
11. What are the proteins retained in whey?
12. How is milk albumin coagulated?

Information Sheet
on
MILK PROTEINS

Proteins are supplied in the human diet by such foods as--lean meat, cheese, and sea foods. They are organic compounds basically made up of carbon, hydrogen, oxygen and nitrogen. The word protein was derived from the Greek word proteios which means "holding first place". This had reference to early beliefs that proteins were the basic elements of all animal tissues. Later study has shown that proteins make up the larger portion of only the soft body tissue. Proteins are involved in the process of cellular growth and they control many metabolic processes in the body. Plants can form proteins directly from the soil and air but animals must derive theirs from the foods they eat.

Proteins are made up of amino acids. Amino acids are nitrogen-bearing compounds that are known as the building blocks of protein. These amino acids make proteins in much the same way that letters form words. Just as many different combinations of letters can form separate words, amino acids of different types join together to form thousands of proteins. There are 18 amino acids that are essential in nutrition and nine of these must be present in foods if life is to continue. The other nine can be formed by the body from the essential ones. The nutritional value of a protein is determined by the number and amount of amino acids present.

About 80% of the protein in milk is casein. This amount will vary slightly between breeds of dairy cattle. Since casein has several commercial uses it is extracted from milk for these purposes. It is separated in the following ways:

1. high speed centrifuging
2. addition of acid to milk
3. souring the milk with the use of bacteria
4. coagulating the milk with the addition of rennin--this is the best method because the casein extracted in this way comes closest to being in the same form that it had when present in the milk.

Casein is usually manufactured from skim milk by one of the acid processes. A yield of 2.5 to 2.9 pounds of casein can be obtained from 100 pounds of skim milk.

Rennet-casein (casein obtained using rennin) is prepared commercially for use in the manufacture of casein plastics. It is derived from skim milk that has been heated to a temperature of 95 to 100 degrees F.

Casein, besides being an important food product has several industrial uses.

Milk Proteins
(Information Sheet continued)

They are:

1. Casein glues

2. Paper coating - This has been the principal commercial use of casein but is declining because of the use of synthetic resins in paper coating.

3. Plastics - Casein plastics are used in the manufacture of buttons, buckles, and costume jewelry.

4. Textiles - Casein fiber closely resembles wool. It is still made in England and Italy but synthetic fibers have made it unprofitable in the United States.

Other uses of casein include use as an adhesive in insecticide sprays, use in medicines, use as an ingredient in dairy feeds, and as a media for bacterial growth in research work.

When the fat and casein are removed from milk, the resulting liquid is called whey. Whey contains a small amount of two soluble proteins: Lactalbumin and lactoglobulin. Next to casein, latalbumin or milk albumin occurs in the greatest amounts in milk. Lactalbumin is coagulated and extracted by heat without the use of rennin. Acid is sometimes used to make the whey more acidic for soluble milk albumin extraction.

Lactoglobulin is a complex of closely related proteins. Globulins are insoluble in water but will dissolve in a weak salt solution. Colostrum milk, the secretion of the mammary gland for a few days after the birth of a calf, is rich in globulins.

Assignment Sheet
for
MILK PROCESSING PLANT EMPLOYEE

UNIT: Nutritional Properties of Milk

TOPIC: Milk Sugar

OBJECTIVE: To learn the characteristics and importance of milk sugar in nutrition and how it affects the milk processor.

REFERENCES:
Required:
Information Sheet, "Milk Sugar"

QUESTIONS OR ACTIVITIES:

1. What is the main carbohydrate in milk?
2. Lactose is a complex sugar made up of what simple sugars?
3. What is the average content of lactose in cow milk?
4. What is preferred for commercial production of lactose?
5. What are the two commercial forms of lactose?
6. List two disadvantages of alpha-lactose.
7. List uses of lactose other than being consumed in milk and milk products.
8. Compare the effect of lactose to other sugars consumed by grown animals.

Information Sheet
on
MILK SUGAR

Lactose or milk sugar is found only in the milk of mammals and is the main carbohydrate therein. It is a disaccharide (composed of two simple sugars) and can be broken down into glucose and galactose. The lactose content of cow's milk averages about 4.92 percent with a possible variation of about 3.7 percent from cow to cow.

Milk sugar is usually prepared from whey that is a by-product of cheese making and the manufacture of casein. The whey from the manufacture of hydrochloric acid casein is preferred in making milk sugar. Sulphuric acid casein is undesirable because it contains elements that tend to make the lactose cloudy. Lactose made commercially falls into the following groups:

1. Alpha-lactose - A fairly insoluble lactose that is only about one-sixth as sweet as cane sugar.

2. Beta-lactose - About seven times more soluble than alpha-lactose. This makes it appear sweeter to the taste and makes it better for use as a sweetner in foods.

The low solubility of lactose in water makes it a problem to the manufacturer of dairy products. This low solubility causes it to "clump" together when it is cooled. When this happens during ice cream production, the finished product will have small, hard crystals of lactose that give rise to a condition known as "sandiness" which is unpleasent to the consumer. The addition of large amounts of sucrose, a very sweet natural sugar, will also cause the "clumping" action to occur.

Milk sugar is consumed in large amounts in milk and milk products, but the sugar itself has only a few industrial uses. Some of these uses are; for the modification of cow's milk in infant feeding, in medicines, bakery products, candies, coffee cream substitutes, military smoke screens, medium for mold growth, silvering of mirrors, and the making of lactic acid. Lactic acid production from whey is being replaced by production from starch and blackstrap molasses. When used in medicines the crude lactose must be further refined to meet pharmaceutical standards.

The function of lactose in nutrition has had little study devoted to it, but it is generally thought that it does not fatten grown animals as readily as does sucrose and other carbohydrates in the daily diet.

Assignment Sheet
for
MILK PROCESSING PLANT EMPLOYEE

UNIT: Nutritional Properties of Milk

TOPIC: Minerals and Water in Milk

OBJECTIVE: To learn the characteristics and importance of minerals and water in milk and how they affect the processor.

REFERENCES:

Required:

Information Sheet, "Minerals and Water in Milk"

QUESTIONS OR ACTIVITIES:

1. The mineral content of milk is usually referred to as what?
2. What are some influences of minerals in milk upon processing dairy products?
3. What metals are resistant to the dissolving action of milk?
4. How much does the calcium content of milk vary?
5. How does pasteurization effect the availability of calcium to the body?
6. What favors the absorption and utilization of calcium by the body?
7. Why is milk not fortified with iron or copper?
8. What is the principal constituent of milk?

Information Sheet
on
MINERALS AND WATER IN MILK

When the water is removed from milk and the remaining solids are burned, a fine, nearly white ash remains. This ash contains the minerals found in milk and, due to chemical changes during the burning, it contains carbonates, oxides, and phosphates which were not present as such in the original milk. The ash of milk is always alkaline or basic in a chemical reaction. The major minerals in milk and ash are shown in the following table.

Element	% in Milk	% in Ash
Potassium	0.14	20.0
Calcium	0.12	17.4
Chlorine	0.10	14.5
Phosphorus	0.09	13.2
Sodium	0.05	7.4
Magnesium	0.01	1.45
Sulfur	0.025	3.6

In addition to the minerals in the table, milk contains small amounts of copper, iron, manganese, zinc, iodine, and boron.

Milk has the ability to dissolve small amounts of copper, iron, and nickel, and other metals, but aluminum and stainless steel are resistant to milk corrosion.

The mineral content of milk is very important in nutrition and it also has an influence on the manufacture of dairy products. Calcium has an effect on the action of rennin in cheese making and some minerals such as copper and iron are responsible for undesirable flavors in milk products.

Minerals in milk, as stated previously, are very important in nutrition. The following minerals are found in varying amounts in milk (refer to table 1) and their relative importance in nutrition should be familiar to the processor of dairy products:

1. Calcium - This mineral makes up about 1.6% of the adult human body weight, which is a larger portion than any other inorganic substance except water. The exact amount of calcium needed in the human diet is not known but a normal requirement seems to be about one gram of calcium for every 100 grams of protein. This amount will vary for different people in different stages of life. Since milk contains more calcium per unit of dry matter than most other food-stuffs it is a good food for meeting the diet requirements of calcium. The calcium content of milk varies little (decreasing or increasing the amount of of calcium in a cow's diet has no effect on the amount of calcium in her milk), which makes it a reliable source of the mineral.

Minerals and Water in Milk
(Information Sheet continued)

When milk is boiled or pasteurized, 10 to 20 percent of the calcium present becomes less available to the human body. Since cow's milk is higher in calcium than human milk the loss is not of great importance in children's nutrition. One quart of milk per day will supply the calcium requirements of a growing child. The lactose in milk sets up an acid medium in the small intestine and favors the absorption and utilization of milk in humans. Milk fat and vitamin D are also required for proper absorption.

2. Phosphorus - Studies have shown that if the diet supplies the proper amounts of calcium and protein, sufficient amounts of phosphorus will also be present.

3. Magnesium - This mineral is tied in with calcium and phosphorus and a deficiency is unlikely to occur in an ordinary diet.

4. Sodium, Potassium, and Chlorine - Sodium and potassium are closely related chemically but they cannot be substituted for each other in the diet. Sodium is found in the blood and other body fluids and potassium is normally found in the body cells. The two work together in keeping a normal balance between cell water content and the fluids that surround them. The chlorine content of milk is closely related to the sodium content. Milk from cows with diseased udders will have a high salt content and will taste salty.

5. Iron - Iron is concerned with the transport of oxygen by the blood. The small amount of iron in milk is insoluble and not adequate for minimum diet requirements. Soluble iron cannot be added to milk because undesirable flavors result.

6. Copper - This mineral is closely associated with iron in body functions. Without copper the body is unable to make use of the iron present but since most foods that contain sufficient iron also have enough copper to meet requirements, copper deficiencies are uncommon. There is a small amount of unsoluble copper in milk and it, like iron, cannot be added to milk because of the resulting off-flavors.

7. Zinc - Zinc is one of the most important trace elements in milk. It is easily dissolved by sour milk products and some reports of zinc poisoning have been reported when sour milk held in galvanized containers was fed to animals.

Minerals and Water in Milk
(Information Sheet continued)

The principal constituent of milk is water. Water makes up about 87% of the total weight of milk. The water carries in solution milk, sugar, mineral salts, and the water soluble vitamins. Suspended milk solids in the water include fat, casein, and insoluble mineral salts.

Assignment Sheet
for
MILK PROCESSING PLANT EMPLOYEE

UNIT: Nutritional Properties of Milk

TOPIC: Vitamins in Milk

OBJECTIVE: To learn the vitamin content of milk and its importance in nutrition and to the processor.

REFERENCES:
Required:
Information Sheet, "Vitamins in Milk"

QUESTIONS OR ACTIVITIES:

1. To what is the Vitamin A activity of plant materials due?
2. With what is most of the Vitamin A in milk associated?
3. On what does the Vitamin A content of milk depend?
4. What vitamins are referred to as the water-soluble vitamins?
5. Which vitamins are included in the B complex?
6. What affects the Thiamine content of milk?
7. What affects the Riboflavin content of milk?
8. How does processing affect the Vitamin C content of milk?
9. How is milk fortified with Vitamin D?
10. Milk is a poor source of what three vitamins?

Information Sheet
on
VITAMINS IN MILK

Vitamins are sometimes called "accessory food factors". A vitamin is a substance found in small quantities in food stuffs that is necessary for normal nutrition and whose absence causes avitaminosis, a deficiency disease.

Vitamin A is a pale, yellow liquid at room temperature. In plants vitamin A activity is closely associated with carotene (derived from the vegetable carrot which is very rich in yellow pigments) which can be converted into the form of vitamin A used in the human body. Vitamin A deficiencies are related to night blindness and xerophthalmia, a disease in which the mucous membrane of the eye dries up. The chart at the end of this topic gives the recommended daily allowances for calories and the important minerals, and vitamins.

The vitamin A content of milk is associated with the milk fat. The vitamin A and related carotenoids are concentrated on the surface of the fat globules and in amounts related to the size of the globules. Vitamin A content in milk varies little among different dairy breeds when they are fed like rations and the measurement is made on the basis of fat content. The vitamin A content of milk depends to a great extent on the following factors:

1. Carotene content of the ration fed
2. Fat content of the milk

The material first identified as vitamin B is now known to consist of several vitamins. The eleven vitamins in the complex that have been identified are very important in human nutrition and are all water soluble. Several of the important ones are:

1. Thiamine - First called vitamin B_1, thiamine deficiencies cause growth retardation and mental and physical fatigue. The amount of thiamine in a cow's ration seems to have little affect on the amount found in her milk. This amount is fairly constant but pasteurization destroys 10 to 20 percent of the original amount. If milk is pasteurized by the short time-high temperature process this loss can be cut to about 3 percent. Milk is a fair but not a rich source of thiamine.

2. Riboflavin - This vitamin was previously called vitamin B_2. Milk is a very rich source of riboflavin along with green-leafy vegetables and meat. The amount of riboflavin in milk depends primarily on the ration of the cow, the largest amount being present when the cow is on green pasture. Unlike thiamine, heat has no effect on riboflavin but when exposed to light, a loss does take place.

3. Niacin - This vitamin is also known as nicotinic acid. Niacin can

be produced by the body from the amino acid tryptophan. Milk is a poor source of niacin, but an excellent source of tryptophan. Light or pasteurization has no effect on the niacin content of milk.

4. Pantothenic Acid - This vitamin gets its name from a greek word meaning "from everywhere" in reference to its presence in most foods. A normal diet usually supplies all the pantothenic acid needed.

5. Folic Acid - Originally known as vitamin M, folic acid is essential for normal body growth. Milk is a poor source of folic acid, but it is present in many other foods.

6. Biotin - Biotin was first called vitamin H and it can be synthesized by microorganisms in the digestive tract.

7. Vitamin B_{12} - Cobalt is an important ingredient in vitamin B_{12} and its presence in milk can be affected by the cobalt content of the cow's diet.

8. Pyridoxine - Milk is a fair source of this vitamin but treatment by heat greatly reduces the pyridoxine content. It is present in many other foods.

9. Vitamin C - Vitamin C or ascorbic acid in cow's milk is fairly constant. The average amount in fresh, raw milk is about 20 milligrams per quart. It is a very important vitamin in human nutrition and it should be noted that most of it is lost in the pasteurization process. The small amount that is left in the milk is usually lost during storage because ascorbic acid oxidizes at a rapid rate when exposed to air and light.

10. Vitamin D - Vitamin D is very important in bone development. A deficiency in babies will lead to a bone disease known as rickets. Milk contains an appreciable amount of vitamin D but it varies with the amount of sunlight and type of diet a cow receives. Because of this variation and its importance in nutrition, it has become a commercial practice to add the vitamin to milk. This addition is usually done by exposing the milk to ultra-violet light. Care should be taken to avoid long exposures as off-flavor may result (about 3 seconds is the normal exposure time).

Assignment Sheet
for
MILK PROCESSING PLANT EMPLOYEE

UNIT: Microbiology and Sanitation

TOPIC: Microbiology of Dairy Products

OBJECTIVE: To learn the importance of microbiology of dairy products affecting the processor and consumer.

REFERENCES:
Required:
Information Sheet, "Microbiology of Dairy Products"

QUESTIONS OR ACTIVITIES:

1. How is the sanitary quality of milk usually judged?
2. What are the two most common forms of bacteria found in milk?
3. The naming system for bacteria gives what information?
4. What is the principal method of controlling bacterial growth in milk?
5. Why are some bacteria both beneficial and detrimental in the processing plant?
6. Pasteurization destroys what organisms?
7. How can the contamination that causes ropy milk be prevented?
8. When are yeasts and molds desirable in dairy products?
9. Why should the enzymes in raw milk be considered in handling the milk?
10. What effect does pasteurization have on enzyme action?
11. Milk must be pasteurized before or immediately after homogenization to prevent the action of what enzyme?

Information Sheet
on
MICROBIOLOGY OF DAIRY PRODUCTS

The quality of milk is dependent upon human control of sanitation practices. To be of good quality milk must come from disease-free cows kept in clean surroundings. To be of low bacteria content milk must be collected with clean equipment and stored at the proper temperature until it is processed and consumed.

The sanitary quality of milk is judged by determining its bacterial content. Bacteria are very small organisms of the vegetable kingdom. Bacteria present in milk become evident through their activities. Since the different bacteria in milk maybe either harmful or helpful it is important to be able to classify and name them.

One method of classifying bacteria is by their shape when viewed under a microscope. Organisms that are longer than they are wide are called bacilli. Bacteria that are round in shape are called cocci. Further identification of bacteria can be made by determining the method by which they divide during reproduction. If the cell remains connected end-to-end after division they form a bead-like chain and are called streptococci. Cocci that form grape-like clusters are called staphylococci and other that form a flat, sheet-like mass of cells are called micrococci. The bacilli and cocci are the most common bacteria in milk. The streptococci are often found in milk that was not cooled properly and micrococci are often found on dirty milking equipment.

Bacteriologists have a system for naming bacteria. The first part of the name gives the genus of the bacteria and the second part gives the species. The name streptococcus lactis means the bacteria is of the genus streptococci and the species lactis.

Temperature is one of the most important factors in controlling the rate of growth of bacteria. They grow fastest in a temperature range of 68 to 98 degrees F. Bacteria in milk grow very slowly when the milk is held at a temperature of 35 degrees F. but growth becomes rapid as the temperature rises to and above 50 degrees F. The rapid cooling of milk as it is produced and keeping it cool thereafter retards the growth of most organisms and many that are present are destroyed by the pasteurization process.

There are two types of bacteria that can withstand the heat of pasteurization. They are:

1. Thermoduric Bacteria - These organisms do not reproduce at

pasteurization temperatures. They may increase the bacteria count (expressed as the number of bacteria per millimeter) to such a high degree that the product will not meet the standards for its grade.

2. Thermophilic Bacteria - These organisms can not only withstand heat, they can also reproduce at high temperatures. With the use of short-time, high temperature pasteurization they can be controlled.

As previously mentioned, bacteria in milk may be either helpful or harmful. Some are always helpful and some always harmful, but most of them will act differently in different situations. For example, streptococcus lactis are essential in the production of buttermilk and cheese but their presence in fresh milk will cause it to sour.

There are some entirely harmless bacteria that survive pasteurization. The kind of bacteria in pasteurized milk depend upon the number and kind present in the raw product. The greater the number in the raw milk and the greater the temperature during pasteurization, the larger the number of bacteria destroyed. It should also be remembered that the younger bacteria are, the more easily they are destroyed by heat.

There are two common defects in milk that are caused by bacteria. They are:

1. Ropy Milk - Ropy milk occurs because of gums and mucins formed by the bacteria. Ropy milk becomes thick or viscous and long threads of slime may be drawn from its surface. It is harmless as far as human consumption is concerned but control is important because of consumer desires. To control ropy milk the source of contamination by the bacteria must be identified. Usually the source is unsterile milking equipment and/or milk storage tanks.

2. Sweet Curd - This defect is caused by bacterial action and is seen as small curds or lumps floating on the surface of the milk. At times the entire mass of milk may form into one large lump. This condition can be controlled by keeping milk cooled to the proper temperature.

Besides bacteria, the following organisms may be found in milk:

1. Yeasts - These are single-celled organisms that are only desirable in milk in the production of certain types of cheeses and fermented milk. They are easily destroyed by pasteurization.

Microbiology of Dairy Products
(Information Sheet continued)

2. Molds - Unlike the single-celled yeasts and bacteria, molds are more complicated in structure. They are necessary for the production of some cheeses but for the most part are undesirable. Like yeasts they are destroyed by pasteurization.

3. Body Cells - In the process of milk production in the udder, white blood cells enter the milk. They are of little significance unless they are present in excessive numbers. The normal count is from 50 to 100 thousand per millimeter. A higher humber than this indicates that the cow may have an udder infection. An inflammation of the udder is called mastitis. The organism causing mastitis is not harmful to man and is destroyed by pasteurization.

Enzymes are organic substances produced by the body to speed up chemical reactions. The enzymes present in milk have no importance in nutrition but must be considered in milk processing because they can cause an undesirable flavor. The more important ones found in milk are:

1. Amylase - This enzyme is found in large amounts in mastitis milk.

2. Catalase - The normal content of catalase in milk is low but there are higher amounts in colostrum and mastitis milk.

3. Lipase - This enzyme can cause rancid flavor in milk. Milk must be pasteurized before and after homogenization to prevent the action of lipase.

4. Phosphatase - Actions of phosphatase are readily controlled by pasteurization.

Assignment Sheet
for
MILK PROCESSING PLANT EMPLOYEE

UNIT: Microbiology and Sanitation

TOPIC: Milk and Diseases

OBJECTIVE: To learn the importance of proper milk production and processing in preventing disease transmission.

REFERENCES:

Required:

1. Information Sheet, "Milk and Diseases"

QUESTIONS OR ACTIVITIES:

1. Where does the contamination of milk with bacteria begin?
2. What has reduced the possibility of contamination from external sources?
3. What are accepted means for preventing the spread of diseases through milk?
4. What is the most common source of milk-borne disease?
5. How do most milk-borne diseases originate in people?
6. List diseases transmitted from milk infected while in the udder.
7. The organism causing Q Fever requires what pasteurization time and temperature?
8. List diseases transmitted from milk contaminated by human source.

Information Sheet
on
MILK AND DISEASES

Milk is known to contain a few bacteria when it is drawn from the cow's udder. This means that the contamination of milk begins when it is in the udder. These initial bacteria may come from the bloodstream of the cow or from external sources. External sources such as air, dust, manure, and unsanitized milking equipment may allow bacteria to enter the udder through the teat canal. Extreme care must be taken to control these external sources. The use of modern dairy equipment such as milking machines and pipelines that carry the milk directly to refrigerated areas help minimize outside contamination.

Although raw milk is an excellent source of disease, there has been a great reduction in the spread of milk borne diseases in recent years. This decrease can be related to the following factors:

1. Care given to the health of the dairy cow.
2. Effectiveness of sanitation and preventive medicine in keeping the population healthy.
3. Almost universal use of pasteurized milk.

The most common cause of milk-borne diseases today is contamination by infected milk-handlers. Most cases of disease are traced to the consumption of raw milk. The following diseases in man can be traced to milk infected while in the udder.

1. Tuberculosis - Due to a nation-wide program in testing for the disease and pasteurization, milk-borne tuberculosis is fairly uncommon today.

2. Brucellosis - In man, brucellosis is called undulant fever. It is found mostly in rural areas where raw milk is consumed, but nation-wide eradication programs have greatly reduced its occurrence. The whey test is used to diagnose its presence in individual cows.

3. Leptospirosis - Known as Weil's disease or infectious jaundice in humans, leptospirosis has been found in some diseased cow's milk. It is doubtful that the disease can be spread to man through the comsumption of diseased milk.

4. Q Fever - The organisms producing this disease are highly resistant to pasteurization, thus, time and temperature in the sanitizing process must be carefully observed. Milk must be held at a temperature of 145 degrees F. for 30 minutes or 160 degrees F. for 15 seconds to destroy the organism.

Milk amd Diseases
(Information Sheet continued)

As previously stated, infected milk handlers are the most common source of milk-borne diseases. Infection by organisms of the salmonella species are the most common. The following are some milk-borne diseases in that group:

1. Typhoid Fever - Good sanitation practices in milk production have almost eliminated milk as a source of this illness. The organism is destroyed when milk is held at a temperature of 140 degrees F. for two minutes. Its introduction into milk can often be traced to infected milk handlers or in the use of polluted water to rinse milking equipment.

2. Paratyphoid Fever - This disease is closely associated with typhoid fever but except for one outbreak in 1951 there has been no milk-borne outbreak in the United States since 1848.

Food poisoning is different from food-borne infection. It can be caused from bacteria or toxic organisms present in food at the time of consumption. Food poisoning is usually connected with the salmonella species of organisms. An exception to this is botulism. Botulism is caused by the toxin formed by the organism clostridium botulinum. It has seldom been associated with milk except in the case of some cheeses. Most food poisoning cases caused by milk and milk products are thought to be the result of human contamination.

Assignment Sheet
for
MILK PROCESSING PLANT EMPLOYEE

UNIT: Microbiology and Sanitation

TOPIC: Antibiotics, Pesticides, and Radioactivity

OBJECTIVE: To learn the effects of antibiotics, pesticides, and radioactivity upon milk and milk products, and their importance to the processor.

REFERENCES:
Required:
Information Sheet, "Antibiotics, Pesticides, and Radioactivity"

QUESTIONS OR ACTIVITIES:

1. What are sources of antibiotic residues in milk?
2. How may antibiotics in milk affect the consumer?
3. How may antibiotics in milk affect the processor?
4. What are the time requirements for using milk after treatment of udders with antibiotics and after intramuscular injection?
5. What is the tolerance for pesticides in milk as required by the Food and Drug Administration?
6. What pesticides are of special interest to the dairyman?
7. Other than from natural sources, most radiation received by people comes from what?
8. What government agency operates sampling stations to protect the public from radioactivity in milk?

Information Sheet
on
ANTIBIOTICS, PESTICIDES, AND RADIOACTIVITY

Farmers and veterinarians use many types of drugs to treat diseased dairy cattle. Penicillin is the most common, but other antibiotics like bacitracin, tetracyclines, oxytetracycline, and streptomycin are also used.

Most antibiotic residues in milk come from the use of medicated feed-stuffs or udder treatments. When an antibiotic is injected into a cow's udder most of it is absorbed into the udder tissue. The portion that remains in the udder may show up in the cow's milk for several days after the antibiotic is administered. If this milk is sold for consumption there is danger to some consumers. Many people are allergic to penicillin. Their reaction to it may be anything from a case of hives to death. Also, some pathogenic organisms will develop tolerances for antibiotics. If such an organism were present in milk and caused disease, treatment with the antibiotic would be ineffective. Antibiotic residues in milk may also affect the processor. Milk containing antibiotics may grade higher than its quality warrants, and may inhibit the production of cheese and cultured milk products. These factors make it very important to be familiar with the time requirements for using milk after the treatment of udders with antibiotics and after intramuscular injections. The time requirements are:

1. Injection into the udder--72 hours after the administration of the last treatment.

2. Intramuscular injection--96 hours after administration of the last treatment.

Because pasteurization has little effect on the antibiotics in milk and there is no quick reliable test for the routine testing of milk for antibiotic content, it is very important to follow instructions carefully when using any antibiotic. If any trace of an antibiotic is found in milk, it is considered to be adulterated.

Pesticide residues in milk are a problem because of their widespread use in all forms of agriculture. The Food and Drug Administration sets tolerances for all food-stuffs. If the content of a pesticide in a food reaches or goes above this tolerance, it cannot be sold for human consumption. In milk this tolerance has been set at zero.

The most common ways for pesticides to get into milk are through the feeding of contaminated rations and spraying the pesticide on the animals skin. Both of these problems can be eliminated through the proper use of pesticides.

The pesticides based on chlorinated hydrocarbons (DDT, TDE, Lindane,

Antibiotics, Pesticides, and Radioactivity
(Information Sheet continued)

Chlordane, Heptachlor, Dieldrin, Aldrin, and Endrin) are of the most importance to the dairyman. They are important because they can be absorbed through the skin and stored in the fatty tissues of the body. Some of this may be transferred to milk fat.

The increased use of nuclear energy and weapons in recent years has made the radioactive level of food-stuffs important. The Division of Radiological Health of the United States Public Health Service is responsible for determining these levels. As time goes on, radioactivity may become of greater and greater concern to the dairyman.

Assignment Sheet
for
MILK PROCESSING PLANT EMPLOYEE

UNIT: Microbiology and Sanitation

TOPIC: Housekeeping Principles

OBJECTIVE: To learn the importance and principles of good housekeeping in the processing plant.

REFERENCES:
Required:
Manual for Milk Plant Operators, Milk Industry Foundation, pp. 722-728

QUESTIONS OR ACTIVITIES:

1. The first impression of housekeeping in a dairy plant indicates what?
2. What are two things that make good housekeeping an important factor in consumer confidence?
3. How can plant tours by the public affect the dairy plant?
4. What is the first essential of good housekeeping?
5. How does the plant condition affect the milk producer?
6. Maintaining order and cleanliness is the responsibility of whom?
7. How does housekeeping affect plant safety?
8. List points in maintaining personal health and cleanliness of plant personnel.

Assignment Sheet
for
MILK PROCESSING PLANT EMPLOYEE

UNIT: Microbiology and Sanitation

TOPIC: Cleaning and Caring for Equipment

OBJECTIVE: To learn the importance, methods, and procedures of properly cleaning and caring for dairy plant equipment.

REFERENCES:

Required:

Manual for Milk Plant Operators, Milk Industry Foundation, pp. 729-777

QUESTIONS OR ACTIVITIES:

1. Milk or milk products may leave what residues on dairy equipment?
2. What is usually required to remove mineral deposits, usually referred to as milkstone?
3. List six ways to keep milk film formation on equipment to a minimum.
4. What will usually give satisfactory abrasive action in cleaning equipment?
5. What may a cleaning operation involve?
6. Into what four groups can dairy cleaning chemicals be classified?
7. The removal of milkstone with acid should be followed by what?
8. What is the recommended temperature of water used for cleaning and how is it determined?
9. Cleaning-in-place (CIP) by recirculation has what advantages?
10. Proper in-place cleaning depends upon what?
11. What is meant by the term "O-R cleaning?"
12. List general steps in hand cleaning most dairy plant equipment.

Assignment Sheet
for
MILK PROCESSING PLANT EMPLOYEE

UNIT: Microbiology and Sanitation

TOPIC: Sanitizing Dairy Equipment

OBJECTIVE: To learn the importance, methods, and procedures of sanitizing equipment.

REFERENCES:

Required:

1. Information Sheet, "Sanitizing Dairy Equipment"
2. Manual for Milk Plant Operators, Milk Industry Foundation, pp. 778-792

QUESTIONS OR ACTIVITIES:

1. What does sanitizing mean in the dairy industry?
2. Name the three steps in sanitizing milk-handling equipment.
3. Who determines the specifications for dairy plant equipment construction?
4. List the temperature and time for sanitizing equipment with hot water.
5. The successful use of a sanitizer depends upon what?
6. Pathogenic organisms are destroyed by moist heat at what temperature and time?
7. What are disadvantages of using live steam?
8. What are common chemical sanitizers in the milk plant?
9. How do chlorine compounds affect dairy metals?
10. List the methods of applying chemical sanitizers.

Information Sheet
on
SANITIZING DAIRY EQUIPMENT

Proper sanitation is essential to the production of safe, high quality milk and milk products. In the dairy industry, sanitizing means the cleaning of the equipment, and, as completely as possible, the destruction of micro-organisms that may be present.

Dairy equipment must be constructed so that it can be sanitized easily. The 3A Sanitary Standards Committee, a group made up of public health officials and representatives of the United States Public Health Service and the Dairy Industry, set specifications for the proper construction of dairy equipment. They also set standards for the proper sanitation of the equipment. The steps for sanitizing are as follows:

1. Rinsing of the equipment with warm water to remove milk residues.

2. Actual cleaning with an alkaline detergent or an acid cleaning compound and then rinsing it away.

*3. Sanitizing the equipment with a heat treatment or chemical agent.

*Recent products available to the dairyman have combined the detergent and the sanitizer, making it possible to combine steps 2 and 3.

If hot water is used to sanitize the equipment it should be at a temperature of not less than 170 degrees F. and applied for not less than 5 minutes. The equipment should be immersed in the water when possible. Live steam is also a satisfactory sanitizing agent but it must be used in a closed container.

Chemical compounds are the most common method of sanitation in modern dairy operations. There are several types available, all having certain advantages in particular situations.

Assignment Sheet
for
MILK PROCESSING PLANT EMPLOYEE

UNIT: Microbiology and Sanitation

TOPIC: Cans and Can Washing

OBJECTIVE: To learn the characteristics of common types of cans, their uses, and methods of washing cans

REFERENCE:
Required:
Manual For Milk Plant Operators, Milk Industry Foundation, pp. 793-802

QUESTIONS OR ACTIVITIES:

1. List the common uses of milk cans.
2. What are the common types of cans?
3. What are the disadvantages of aluminum cans?
4. Regulations for bulk milk dispensers often require what type of can?
5. How should empty cans be stored?
6. Bulk dispenser cans may require hand washing because of what?
7. List steps in hand washing cans.
8. List successive steps in mechanical can washers.
9. The solution best suited for washing cans depends upon what?
10. List steps in cleaning the can washer.
11. What are causes of mechanical difficulties of the can washer?
12. What may cause heavy scale deposits in the can washer?

Assignment Sheet
for
MILK PROCESSING PLANT EMPLOYEE

UNIT: Microbiology and Sanitation

TOPIC: Bottle Washing

OBJECTIVE: To learn the importance and procedures of proper bottle washing.

REFERENCES:
Required·
Manual For Milk Plant Operators, Milk Industry Foundation, pp 803-823

QUESTIONS OR ACTIVITIES:

1. List three methods of bottle washing.
2. When is hand washing usually used?
3. What is usually used in washing bottles by hand?
4. Pressure type washers are used in what type of plants?
5. What is used to descale the pressure type bottle washer?
6. What is the first step in using soaker type washers?
7. What are requirements in Texas for bottle washing solutions?
8. What provides efficient sterilization of bottles?
9. What is the purpose of testing the caustic solution?
10. Why is chlorine treatment of the final rinse on the bottle washer used?
11. What parts of the bottle washer are lubricated with oil or grease?
12. What is used to lubricate the conveyor between washer and bottle filler?

Assignment Sheet
for
MILK PROCESSING PLANT EMPLOYEE

UNIT: Microbiology and Sanitation

TOPIC: Insect and Rodent Control

OBJECTIVE: To learn the fundamentals of preventing and controlling insects and rodents in the dairy plant.

REFERENCES:

Required:

Manual For Milk Plant Operators, Milk Industry Foundation pp 843-856

QUESTIONS OR ACTIVITIES:

1. What is the "Preventive Concept" of insect and rodent control?
2. Of what significance is the "mayhave" clause in the Federal Food, Drug. and Cosmetic Act?
3. Who is held responsible for the presence of rodents and insects in the plant?
4. What are the common insects and rodents found in the milk plant?
5. What are the basic procedures for preventing a fly problem?
6. How are flies kept out of the buildings?
7. Where should the milk plant operator obtain information on the best kinds of insecticide to use in his plant?
8. What are the basic procedures for preventing a roach buildup?
9. Can environmental and insecticide control give satisfactory roach control?
10. What are the 5 essential practices for effective rodent control?

Assignment Sheet
for
MILK PROCESSING PLANT EMPLOYEE

UNIT: Milk Quality and Control

TOPIC: Grades and Classes of Milk

OBJECTIVE: To learn the grades and classes of milk as applied to processing plants.

REFERENCES:
Required:
Information Sheet, "Grades and Classes of Milk"

QUESTIONS OR ACTIVITIES:

1. What are the two general types of milk?
2. Why is cream permitted to have a higher bacterial count than milk?
3. Milk regulations are designed for what purposes?
4. The marketing of milk and milk products is regulated by whom?
5. What is "Certified Milk?"
6. What are the maximum bacterial counts for raw and pasteurized Certified Milk?
7. List requirements for Grade A Raw Milk.
8. What are the three grades of raw and pasteurized milk?
9. The most expensive form of milk is what?
10. Classes II and III milk are used for what purposes?
11. Federal Milk Marketing Orders set what prices?
12. What are advantages of Federal Milk Marketing Orders?

Information Sheet
on
GRADES AND CLASSES OF MILK

Milk, like most food products, is separated in to grades and classes. This separation is based on several factors that will be discussed in this lesson. Milk can be divided into two general types:

1. Market Milk - More stringent control is placed on market milk because it is supplied to the consumer in its liquid state.

2. Manufacturing Milk - This lesser quality milk is used in the manufacture of butter, ice cream, cheese and other milk products.

Most health departments have sanitary codes which cover the grading of milk. This code is often based on the Milk Ordinance and Code of the United States Public Health Service. Inspectors from the health departments visit the dairy farms and processing plants to supervise sanitary procedures.

Most states and large cities have standards for the bacteria count of milk products. Usually, cream is allowed to have a higher bacteria count than milk because, in the separation process, bacteria are carried mechanically from the milk into the cream. These established milk regulations are designed to prevent fraud and adulteration, and to cover the many factors that affect sanitation and public health. The marketing laws affecting milk are regulated by federal, state, and local laws and ordinances.

There are several grades of milk and because of differences in state and local procedures, it is impractical to define general standards for grades except in the case of certified milk. The bacterial standards quoted in this lesson are those suggested by the United States Public Health Service Milk Ordinance and Code and may not fit local situations. The grades of milk are as follows:

1. Certified Milk - This grade of milk was orginally produced when sanitary standards of production were low. The high quality Grade A milk produced today has drastically cut production of Certified Milk.

   Certified Milk is a copyrighted name given to milk produced in dairies that operate under rules published in the "Methods and Standards for the Production of Certified Milk" issued by the American Association of Medical Milk Commissions, Inc., New York. These rules are to assure purity, uniformity and adaptability of the milk for infants and growing children. The production of Certified Milk involves the veterinary inspection of cows and sanitary inspection of the dairy farms and equipment. It also involves the medical inspection of the employees that handle the milk.

   The standards for Certified Milk require that it does not contain over 10,000 bacteria per milliliter and not more than ten coliform

Grades and Classes of Milk
(Information Sheet continued)

organisms are allowed to be present in a like amount. After it has been pasteurized it cannot contain more than 500 bacteria and one coliform organism per millimeter.

2. Grade A Raw Milk - This grade is produced by dairies satisfying state and local requirements. Cows must be tested and found free of tuberculosis and brucellosis and the bacteria count cannot exceed 50,000 per milliliter. Grade A Raw Milk for pasteurization and the bacteria count as delivered from the farm may not exceed 200,000 per milliliter. Grade A Pasteurized Milk must pass a phosphatase test and the bacteria count must not exceed 30,000 per milliliter. Coliform organisms must not exceed 10 per milliliter.

3. Grade B Milk for Pasteurization - This is milk that does not meet bacterial requirements for pasteurization, but does conform in all other categories. The bacteria count must not exceed 1,000,000 per mililiter as delivered from the farm. Grade B Pasteurized milk must not exceed a bacteria count of 50,000 per milliliter. In some areas the retail sale of Grade B milk or lower is prohibited.

4. Grade C Milk - This is milk that does not meet any requirements for Grade B.

Milk is also given an economic classification. The most expensive classification is Class I, milk in its fluid form. Class II and Class III milk are priced lower than Class I because they are used in the production of cottage cheese, ice cream, evaporated milk, dried milk products, hard cheeses, butter, and cultured milk products.

In many areas dairy farmers produce milk under Federal Milk Marketing Orders. These regulations govern the price of milk to insure a reasonable profit to those engaged in milk production, prices may be adjusted up or down as local situations warrant. The Federal Orders provide a stable and orderly market for producers that sell fluid milk because competition of raw milk buyers is regulated. It should be remembered that Federal Orders are not price supports.

Assignment Sheet
for
MILK PROCESSING PLANT EMPLOYEE

UNIT: Milk Quality and Control

TOPIC: Flavor and Physical Defects

OBJECTIVE: To learn factors that affect the flavor of milk and cause other defects.

REFERENCES:

Required:

1. Manual for Milk Plant Operators, Milk Industry Foundation, pp. 542-560
2. Information Sheet, "Flavor and Physical Defects"

QUESTIONS OR ACTIVITIES:

1. What substances affect the taste buds?
2. How does the flavor of milk affect the nutritive value?
3. Defects may be divided into what four groups?
4. How can feed flavor defects be controlled?
5. Name off-flavors due to biochemical change.
6. What off-flavor may be caused by processing procedures?
7. A salty flavor may be due to what?
8. What pasteurization temperatures cause a cooked flavor?
9. What are two physical defects in raw milk?
10. List physical defects caused by processing procedures.

Information Sheet
on
FLAVOR AND PHYSICAL DEFECTS

Sweet, sour, salty, and bitter are the four sensations perceptible to the taste buds of the tongue. Flavor has been defined as the sensations perceived in the mouth and smell perceived through the inner nasal passages.

The taste buds are affected only by the substances that are in solution. The natural flavor of milk is pleasant and slightly sweet. Milk with a natural fat content above 5 percent usually does not have as good a flavor as milk with a fat content between 3 and 5 percent.

In appraising flavor the sense of touch is an important factor. Milk of low fat content fortified with non-fat milk solids acquire an improved flavor over whole milk.

The flavor of milk is the major determinate in the amount of milk consumed. Even though the flavor has little to do with the nutritive value of milk, both the producer and the processor should be concerned with the flavor of milk.

Milk with an off-flavor will not be consumed in the same degree as milk with its normal, agreeable flavor, even though it may be safe to drink. Milk that is off-flavor is caused by several flavor defects. These defects may be caused by:

1. feed
2. biochemical changes
3. condition of cow
4. environment

It is common for off-flavor of milk to come from feed. Feedstuffs such as alfalfa, wild onions, garlic, pepper grass, lodino clover, corn silage, rye, fescue, orchard grass, and water containing moss and algae give milk a feed flavor.

Milk that obtains an off-flavor after it has left the cow usually is caused by a biological or chemical change. A common chemical defect is that of milk with an oxidized flavor. A biological defect of milk is rancid flavor. The organisms that cause rancidity will be active at a lower temperature than most other bacteria found in milk. The bacteria that causes milk to have a rancid flavor will be destroyed during pasteurization due to the high temperatures.

The environment in which the milk is placed may cause the milk to have a flavor defect. Milk will readily absorb such odors as "cowy", "barny", or odors within the refrigerator.

The off-flavor of milk is also due to the physical condition of the cow. A quarter

Flavor and Physical Defects
(Information Sheet continued)

or all quarters of an apparently healthy cow may produce milk that has an off-flavor. The stage of lactation may also have an effect upon the flavor of the milk.

Assignment Sheet
for
MILK PROCESSING PLANT EMPLOYEE

UNIT: Milk Quality and Control

TOPIC: Sampling

OBJECTIVE: To learn the importance and proper procedures of sampling and judging milk.

REFERENCES:
Required:
Manual for Milk Plant Operators, Milk Industry Foundation, pp. 562-569

QUESTIONS OR ACTIVITIES:

1. What is required for any accurate test of milk?
2. What is the first requirement in obtaining a representative sample?
3. What is composite sample?
4. What determines the amount to obtain when taking single samples for composite sample?
5. What is probably the most commonly used method of sampling milk?
6. Why should a preservative be added to the composite sample bottle?
7. What quantity of milk should be obtained for a test?
8. List steps in judging milk for off-flavors.

Assignment Sheet
for
MILK PROCESSING PLANT EMPLOYEE

UNIT: Milk Quality and Control

TOPIC: Bacteriological Tests

OBJECTIVE: To learn the methods and procedures of conducting bacteriological tests in the milk processing plant.

REFERENCES:

Required:

1. Information Sheet, "Bacteriological Tests"

Supplemental:

2. Manual for Milk Plant Operators, Milk Industry Foundation, pp. 574-577

QUESTIONS OR ACTIVITIES:

1. Health departments and control laboratories usually use what bacteriological test?
2. What is agar?
3. What is a colony?
4. List the three common dilutions of the milk sample for the standard plate count.
5. How would a colony count of 330 in 1:100 dilution plate be reported?
6. What causes "pin-point" colonies?
7. What are objections to the agar plate count?
8. List modifications of the standard plate count.
9. Name four stains that may be used in the Direct Microscopic Count.
10. Why is the Direct Microscopic Count not useful in examining fresh pasteurized milk?
11. What do Dye Reduction Tests indicate?
12. What are advantages of Resazurin over Methylene Blue Reduction?

Information Sheet
on
BACTERIOLOGICAL TESTS

The health departments and control laboratories use the standard plate count which is reliable to determine a few or millions of bacteria in a milliliter.

Using the standard plate count a small known amount of milk is mixed with a jelly-like medium in a Petri dish. This medium is agar which contains nutrient materials that favor the growth of bacteria. The bacteria found in the milk are nourished, grow, and reproduce within the Petri dish. As the bacteria grow in number, they become visible to the eye and are called a colony. The colony may be composed of a group of bacteria or one living bacterium.

The standard plate count uses three common dilutions of milk. They are 1:10, 1:100, and 1:1000. To make the 1:10 solution one part sample would be added to 9 parts of sterile, phosphate-buffered distilled water.

To report the Standard Plate Count per milliliter only, use the two significant left-handed digits, round off the third digit and multiply by strength of dilution. For example 116 in 1:100 dilution plate is reported as a Standard Plate Count of 12,000 per mililiter.

To be able to judge a quantity of milk accurately, a series of at least four or more samples should be examined.

Pin-point colonies are colonies which are difficult to see, and may result because:

1. Temperature of the particular medium used prohibited growth of bacteria.

2. Or colonies do not develop well because of competition for food due to the presence of so many bacteria which limited colony development.

Heat in most cases will kill the bacteria found in milk. The pasteurization process will usually destroy 96-99% of the bacteria in milk.

The standard plate count requires two days for results to be obtained and much equipment is necessary. Several modifications have been proposed and adopted to use on low-count raw milk. They are:

1. micro-plate

2. oval tube

3. roll tube

Bacteriological Tests
(Information Sheets continued)

The Direct Microscopic Count can estimate the number of bacteria in milk by actual count using a microscope.

A stained slide is examined under a microscope. The slide is prepared by staining and drying 0.01 milliliter of milk over 1 square centimeter area of a glass slide.

The sample may be stained by any one of four procedures. These procedures are:

1. acid and water-free stain
2. aniline oil methylene blue stain
3. Newman-Lampert stain
4. Levowitz-Weber stain.

Even though the dead organisms do not stain as well as living bacteria, they can also be counted using the microscopic count method.

Only a small sample of milk is used in the microscopic count and only milk that contains more than 50,000 bacteria per milliliter. Because pasteurized milk contains only a small amount of viable bacteria but the killed organisms will stain well for some time after pasteurization, this method should not be used with pasteurized milk.

Thermophilic organisms, rod-shaped organisms in milk pasteurized by the batch-holding method, may be detected by the microscopic count method.

Checking bacteriological quality and grading raw milk may be accomplished by reduction tests with methylene blue or resazurin. The reduction method indicates the degree of activity of certain types of bacteria. This allows classifying milk as acceptable or nonacceptable for certain grades or uses.

Not only does the Resazurin Reduction Method detect milk from diseased udders and the presence of colostrum, but it also gives results within three hours which is an advantage over the Methylene Blue Reduction Method.

Assignment Sheet
for
MILK PROCESSING PLANT EMPLOYEE

UNIT: Milk Quality and Control

TOPIC: Butterfat Tests

OBJECTIVE: To learn the methods of testing for butterfat and the procedures for each method.

REFERENCES:
Required:
Information Sheet, "Butterfat Tests"

QUESTIONS OR ACTIVITIES:

1. What is usually used to determine the price of milk to the dairyman?
2. What is the most commonly used test for butterfat?
3. List the steps in the Babcock test.
4. What may cause dark-colored fat columns or columns that contain charred materials?
5. Pale-colored fat columns are caused by what?
6. What is needed to test skim milk or buttermilk by the Babcock method?
7. A modification of the Babcock method to test skim milk is called what?
8. Why is cream weighed for the Babcock test?
9. List other methods of testing for butterfat.
10. What test is used for an exact determination of fat in evaporated milk, ice cream, cheese, and dry milk?

Information Sheet
on
BUTTERFAT TESTS

Fat content determines the amount a dairyman is usually paid for the milk he sells. If the milk is to be used in manufacturing dry milk or cheese, sometimes the dairyman has an allowance made for the non-fat solids in the milk.

In most creameries in the United States the Babcock Fat Test is used to determine the fat content of milk and cream.

Following is the procedure of the Babcock test developed by Professor S. M. Babcock of the University of Wisconsin about 1890.

1. By means of a Babcock pipet place 17.5 milliliters of sample in the Babcock milk test bottle.

2. After adding 17.5 milliliters of sulfuric acid, rotate the milk and acid until all traces of undissolved curd have disappeared.

3. Centrifuge the bottle for 5 minutes, being sure the centrifuge is heated to 140 degrees F.

4. Fill the bulb of the bottle with 140 degree F. water.

5. Add more hot water so that fat approaches the top graduation of the bottle after whirling for 2 minutes.

6. Again whirl for 1 minute.

7. Place bottle in water bath that has a temperature of 130-140 degrees F. for at least 3 minutes.

8. With a pair of sharp-pointed dividers measure the percentage of fat. The points of the dividers should be placed at the extreme bottom of the fat column and at the top of the meniscus. The crescent-shaped portion on top of the fat column, due to cohesion of the fat with the glass is called the meniscus.

Too much acid or acid which is too strong or too warm when mixed with milk, or acid and milk allowed to stand in the bottle too long before mixing, or improper or inadequate shaking to mix the milk and acid will cause dark-colored, containing charred matter, fat columns.

Pale-colored fat columns are caused by: Weak acid, not enough acid, temperature of acid or milk too cold, or an insufficient amount of mixing.

Butterfat Tests
(Information Sheet continued)

Due to the small amount of fat in skim milk and buttermilk, the Babcock method can be used if the test bottle is made with a very small graduated neck to measure the fat.

Another method of determining the amount of fat in skim milk is to use the modification of the Babcock test called the butyl alcohol test. In this test butyl alcohol, skim milk or buttermilk, and sulfuric acid is mixed and centrifuged for 6 minutes. The percentage of fat is obtained by doubling the fat reading.

Milk is measured by volume, but due to the variations of thickness of cream it is weighed. After using 9 or 18 grams of cream depending on size of the bottle it is tested by the same procedure practically as milk. Because cream has a higher fat content the cream test bottle has a larger neck than the test bottle used for milk.

In order to obtain an accurate test of cream the meniscus has to be destroyed. This is accomplished by adding a small amount of colored mineral oil, called glymol which levels off the meniscus and allows an accurate reading.

Other methods used to test for butterfat are:

1. The Gerber or Fucoma Fat Test

2. Combined acid and detergent test for milkfat

3. Detergent tests (BDI test and the TESA or Banco test)

4. Ether Extraction (Mojonnier Method)

The Gerber or Fucoma Fat Test separates the fat from the sample, like the Babcock test, by using chemicals and a centrifuge. To prevent formation of charred matter which may happen when sulfuric acid is used alone, isoomyl alcohol is used. Special pipets and equipment are used to add the acid and alcohol to special test bottles called butyrometers.

The combined acid and detergent test for milkfat makes use of a cationic detergent, glacial acetic acid. Sulfuric acid is also used.

Before the detergent tests used for the quantitative determination of fat in milk products can be adopted more investigational work is needed.

The Ether extraction (Mojonnier test) is widely used to test for fat in evaporated milk, ice cream, cheese, and dry milk.

Assignment Sheet
for
MILK PROCESSING PLANT EMPLOYEE

UNIT: Milk Quality and Control

TOPIC: Solids-Not-Fat Tests

OBJECTIVE: To learn the principles, methods, and procedures of determining the solids and solids-not-fat content of milk.

REFERENCES:
Required:
Information Sheet, "Solids-Not-Fat Tests"

QUESTIONS OR ACTIVITIES:

1. How is the content of total solids or solids-not-fat usually determined?
2. How is the specific gravity determined?
3. List two common types of lactometers and the temperature of the milk for each.
4. Define lactometer degree.
5. The graduations on a Quevenne lactometer are read how?
6. How is the Watson lactometer graduated?
7. List steps in taking a lactometer reading.
8. List the Babcock formulas for SNF and Total Solids when using a Quevenne lactometer at 60°F.
9. What is the usual minimum specific gravity of normal milk?
10. What test is used in determining the total solids in milk products?

Information Sheet
on
SOLIDS-NOT-FAT TESTS

There are many procedures for determining the solids content of milk. This is usually determined from the fat content and specific gravity. The specific gravity of milk is found by using an instrument called a lactometer, which is a special form of a hydrometer. The two most common types of lactometers used are: The Quevenne lactometer, used with milk at 60 degrees F. and the Watson lactometer, used with milk at 102 degrees F. These instruments are read in terms of lactometer degrees. A lactometer degree is 1000 times the specific gravity minus 1000. The Quevenne lactometer has a graduated scale from 15 to 40 and these degrees correspond to specific gravities ranging from 1.015 to 1.014. The Watson lactometer reads from 26 to 37.

If readings with the Quevenne lactometer are taken at any temperature other than 60 degrees F., corrections must be applied to the reading. In most cases between 50 degrees F. and 70 degrees F., the lactometer reading will increase or decrease .01 degree for each degree of temperature above or below 60 degrees F. When using the Watson lactometer and the milk varies more than 2 degrees F. from either side of 102 degrees F. a correction of .02 degrees for each degree of temperature must be used.

The specific gravity of milk is not constant. At the time of milking the fat content is warm and in a liquid state but as the milk is cooled the fat solidifies and becomes smaller in volume of milk to become smaller and the specific gravity to increase. This action is known as the Recknagle effect and must be considered when the specific gravity of a milk sample is measured at 60 degrees F. Failure to do so may result in a specific gravity that may be .01 percent or more too low. Lactometer readings made at 102 degrees F. are intended to avoid the Recknagle effect but comparisons between the two methods has shown that there is little difference in the results.

The following steps should be used when taking a lactometer reading:

1. Place a well mixed milk sample of milk in a container large enough to float the lactometer and filled so that it will over-flow when the lactometer is placed in it.

2. Place the lactometer in the milk and let it float freely for about 30 seconds.

3. After blowing off any bubbles on the surface of the milk, read the lactometer scale at the highest point reached by the milk meniscus around the lactometer scale (a miniscus is the dish-shaped depression formed on the surface of a liquid when a cylindrical object is dipped into it).

When the lactometer reading has been taken, the total solids or solids-not-fat content

Solids-not-fat Tests
(Information Sheet continued)

of the milk sample can be found by using the following formulas:

1. Babcock Formula - For use with the Quevenne lactometer read at 60 degrees F.

$$\text{Solids-not-fats} = \frac{\text{Fat Percent}}{5} + \frac{\text{Corrected Lactometer Reading}}{4}$$

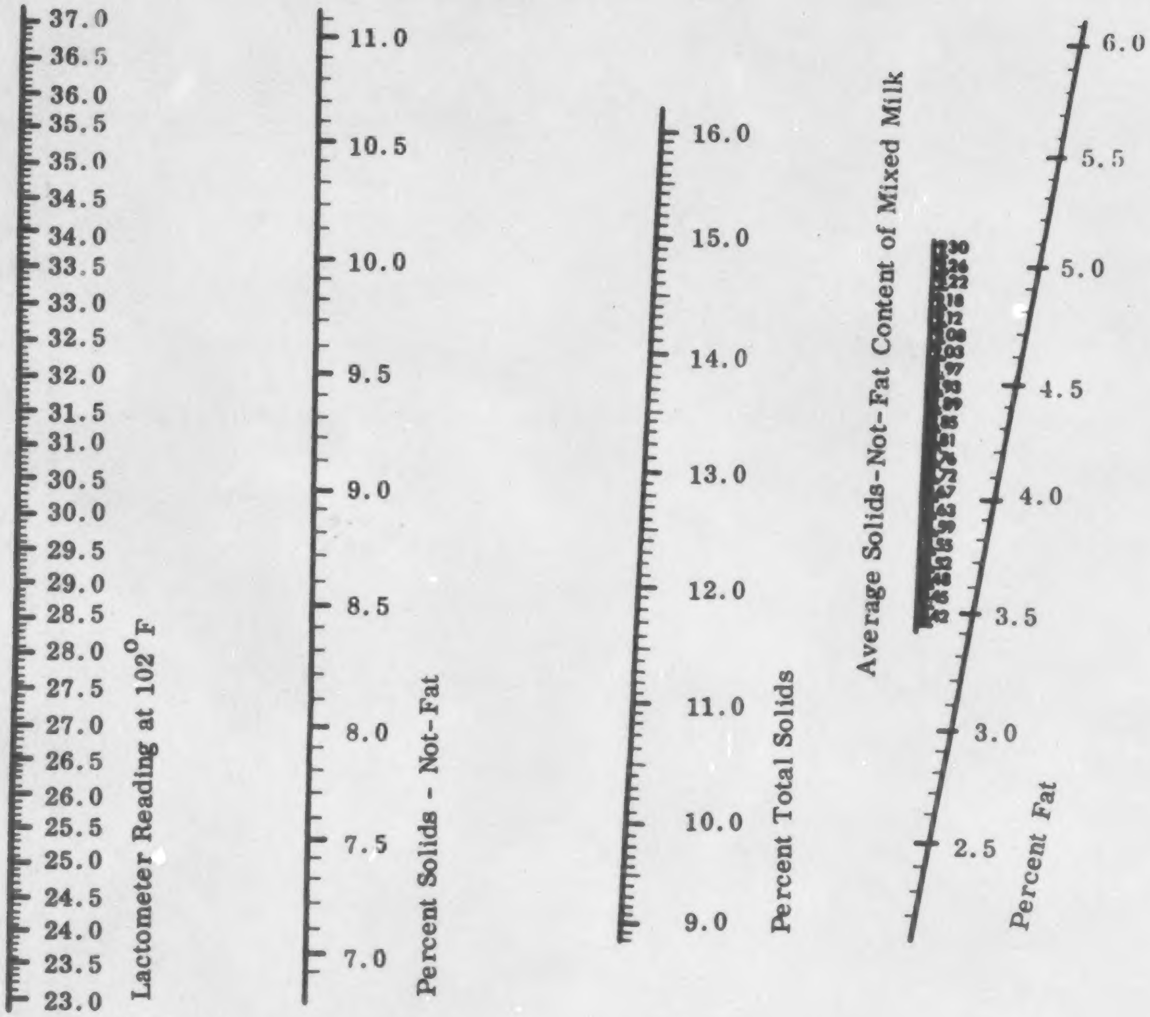
$$\text{Total Solids} = 1.2 \text{ Fat Percent} + \frac{\text{Corrected Lactometer Reading}}{4}$$

2. Babcock Formula - For use with the Watson lactometer read at 102 degrees F.

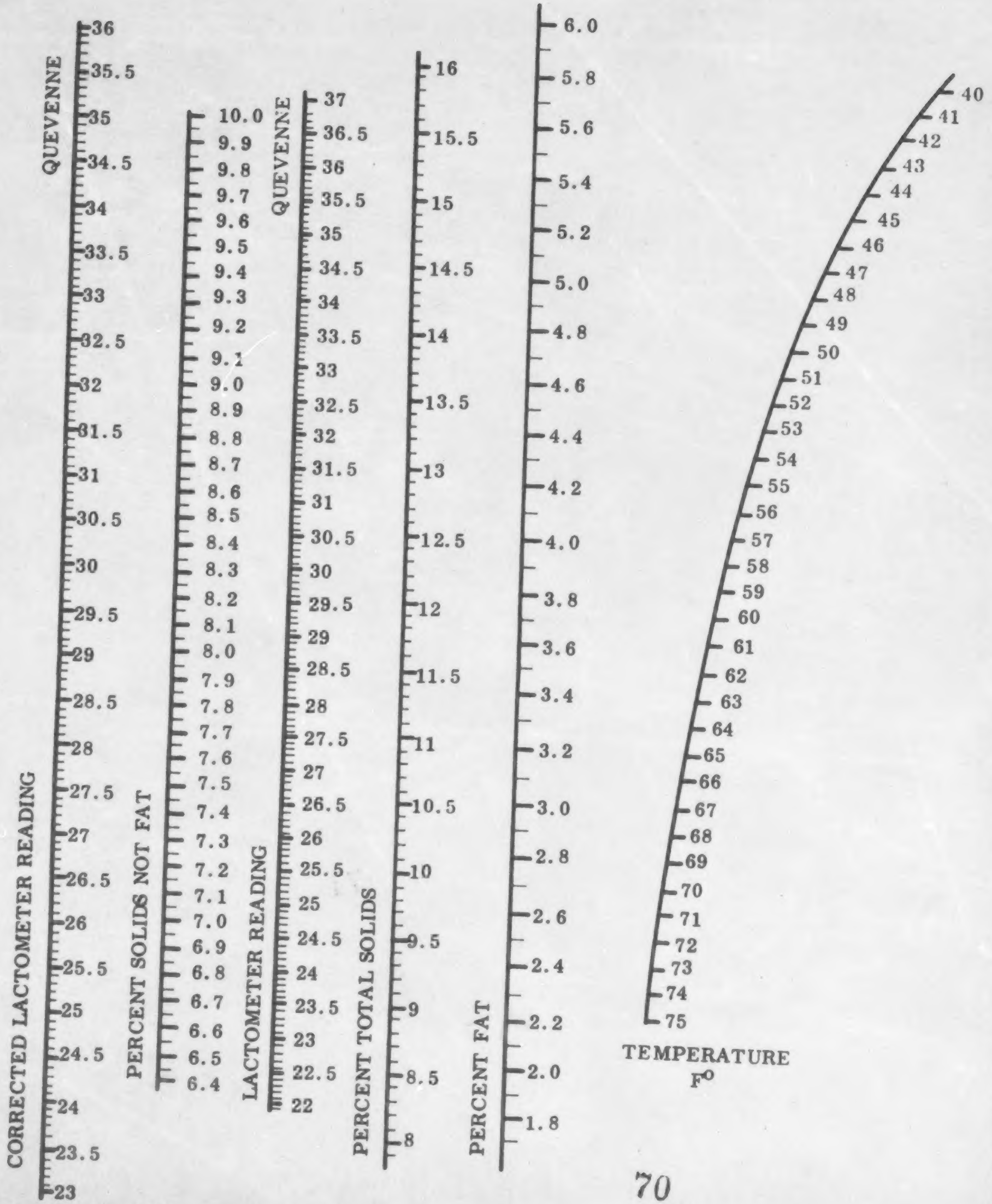
F = Percent Fat
L = Lactometer Reading

The above formulas need not be used if a nomograph (shown below) can be secured.

Solids-not-fat Tests
(Information Sheet continued)



Solids-not-fat Tests
(Information Sheet continued)



Solids-not-fat Tests
(Information Sheet continued)

Lactometers can also be used for detecting milk to which water has been added. Normal milk, measured at a temperature of 60 degrees F., will rarely have a specific gravity of less than 1.030. A lower lactometer reading would mean that the milk may have been adulterated.

Another method to determine the total solids content of milk is the Gravimetric test. It is performed by heating a weighed sample of milk until it is completely dry. It is then weighed again, and the dry weight allows calculation of the water loss. When the weight of the water is subtracted from the total sample weight the total solids content can be obtained.

Assignment Sheet
for
MILK PROCESSING PLANT EMPLOYEE

UNIT: Milk Quality and Control

TOPIC: Acidity Tests

OBJECTIVE: To learn the importance and principles of tests for acidity in milk.

REFERENCES:
Required:
Information Sheet, "Acidity Tests"

QUESTIONS OR ACTIVITIES:

1. The degree of acidity of milk is a rough measure of what?
2. Acidity measured in percent is expressed as what?
3. How is acidity measured in percent determined?
4. What is the standard alkali solution used in titration?
5. What is used as the indicator for titration?
6. Give the formula for determining percent acidity by titration.
7. A pH value of 7, below 7 and above 7 means what?
8. List two methods used to measure pH.
9. What effect do buffers have?

Information Sheet
on
ACIDITY TESTS

An appreciable amount of lactic acid is not found in fresh milk or cream, therefore the age and bacterial activity of milk can be roughly measured by its acidity.

When the acidity is more than 0.3%, as it is in sour milk, it is expressed as lactic acid.

A 0.1 normal sodium hydroxide solution, standard alkali solution, is used to neutralize the acid. Titration is the method used to determine acidity. To neutralize 0.009 grams of lactic acid, one milliliter of 0.1 normal alkali solution is required.

The indicator for the titration is a 1% solution of phenolphthalein in alcohol. Phenolphthalein changes color in presence of alkali. Whereas it is colorless in an acid solution and it becomes pink in an alkali solution.

The formula for determining percent of acidity by titration is:

$$\%\ \text{acidity} = \frac{\text{ml. } 0.1\ \text{N alkali} \times 0.009}{\text{weight of sample}} \times 100$$

The acidity of milk is increased because lactic acid is formed when bacterial fermentation takes place.

A solution is considered neutral in reaction when it has a pH of 7. To be neutral is the condition where the basic or alkaline ions are equal in number to the acid ions. As the solution is neutral with a pH of 7, a pH of greater than 7 indicates alkalinity and a solution with a pH of less than 7 indicates acidity.

One method of determining pH is using the phenolphthalein color solution, previously discussed; another method utilizes electrical apparatus.

There are substances in milk, phosphates and mineral salts, which are buffers. Buffers tend to resist change in the pH of milk and try to hold it constant.

Assignment Sheet
for
MILK PROCESSING PLANT EMPLOYEE

UNIT: Milk Quality and Control

TOPIC: Miscellaneous Tests

OBJECTIVE: To learn the principles and procedures of miscellaneous tests used in the processing plant.

REFERENCES:
Required:
Information Sheet, "Miscellaneous Tests"

QUESTIONS OR ACTIVITIES:

1. Why are tests for sediment important?
2. What is the purpose of the test for phosphatase?
3. The testing of butter usually includes what?
4. What is the most accurate means of detecting added water in milk?
5. What is the freezing point of milk?
6. What is used for testing the freezing point of milk?
7. What effect does the breed of the cow or her feed have upon the freezing point of milk?
8. The test to distinguish goat's milk from cow's milk is based upon what?

Information Sheet
on
MISCELLANEOUS TESTS

Inspection services use special equipment to detect the presence of sediment in milk or cream. A cotton filter disc is used to collect sediment through which a pint sample has been forced by air pressure or vacuum.

Foreign matter in milk is objected to because:

1. The presence of dirt

2. An indication of carelessness during processing

3. The probability of other foreign matter being in the solution.

To be able to determine proper pasteurization or if a milk product contains the raw product to a detectable amount can be accomplished by a test for phosphatase. Phosphatase, an enzyme, is contained in raw milk. Certain organic compounds of phosphoric acid will be decomposed in the presence of phosphatase and alkali. Public health officials are also concerned with this test because, the heat necessary to give a negative phosphatase test will also be sufficient to destroy any pathogenic organisms present.

The content of fat, moisture, and salt in butter is also tested. To check for moisture, water is evaporated from the sample in a hot plate over a fire. When the salt and curd have collected on the bottom of the dish and the melted fat has become amber colored the water has been considered evaporated.

To determine the weight of the fat in the sample substract the weight of the dry residue from the weight of the melted fat and residue. To be able to remove the fat from the sample use the following procedure. Dissolve the fat in light gasoline or petroleum ether, then allow the salt and curd to settle. Extract the solution three times being careful not to lose any of the residue. reweigh after cooling.

To detect added water in a milk sample the most accurate way is to measure the freezing point of the sample. Milk has a freezing point of 31 degrees F. Therefore the more water added to a sample, the closer the freezing point comes to pure water which is 32 degrees F. The Hortvet cryoscope is the apparatus most commonly used for testing the freezing point.

The milk obtained from cows which have consumed a large amount of water can have a high freezing point, but the freezing point of milk is not effected either by the breed of cow or the feed the cow has eaten.

Cow's milk gives a clear transparent aqueous layer when mixed with sodium

Miscellaneous Tests
(Information Sheet continued)

hydroxide solution, ethyl alcohol, ethyl ether, and petroleum ether. Goats milk treated in the same way has an opaque aqueous layer. This is due to the relative insolubility of the protein in goat's milk when dissolved in an alkaline solution compared to cow's milk.

Since many people need a sucrose-free milk product, the dietetic milk products need to be examined to see if they are correctly labelled. The test used for this purpose is the Seliwanoff reaction.

Assignment Sheet
for
MILK PROCESSING PLANT EMPLOYEE

UNIT: Milk Quality and Control

TOPIC: Standardizing Dairy Arithmetic

OBJECTIVE: To learn the applications of arithmetic in the dairy processing plant and the procedures in standardizing milk and milk products.

REFERENCES:

Required:

1. Information Sheet, "Standardizing Dairy Arithmetic"
2. Manual for Milk Plant Operators, Milk Industry Foundation, pp. 586-592

QUESTIONS OR ACTIVITIES:

1. How is the average percentage of fat contained in two or more lots of milk, cream, or other products calculated?
2. What is meant by standardization of milk and cream?
3. The Pearson Square Method is used for what purpose?
4. The results on the right hand side of the Pearson Square mean what?
5. Give the ratio-proportion formula to use in determining a definite amount of desired product.
6. Using the Pearson Square, determine the amounts of 38% cream and 1% skim milk to obtain 900 lbs. of 18% cream.
7. Give Jacobson's formula used in estimating the composition of milk.
8. 600 lbs. of 4% milk contains how many lbs. of fat?

Information Sheet
on
STANDARDIZING DAIRY ARITHMETIC

Since the fat content of milk varies from cow-to-cow it is necessary to adjust the fat percentages in retail products so that the consumer will know what he is buying. This process of adjusting the fat content of milk and cream is known as standardization.

In order to carry out the process of standardization, calculations to determine the amount of fat or skim milk to add to a sample must be done. Professor R. A. Pearson or Cornell University developed a simple method, known as Pearson's Square, to use in the computations.

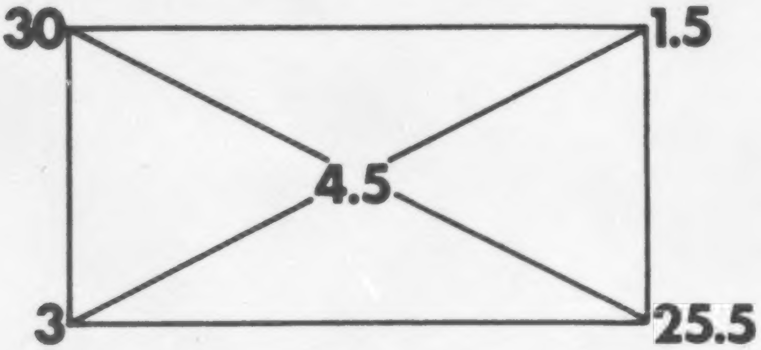
The following steps give the procedures for the use of Pearson's Square:

1. A square is drawn with lines connecting opposite corners.

2. In the center of the square where the diagonals cross, place the percentage of milk fat desired.

3. At the left-hand corners place the percentages of milk fat in the materials to be mixed.

4. Subtract along diagonal lines the smaller number from the larger number and place the difference at the opposite end of the diagonal lines.



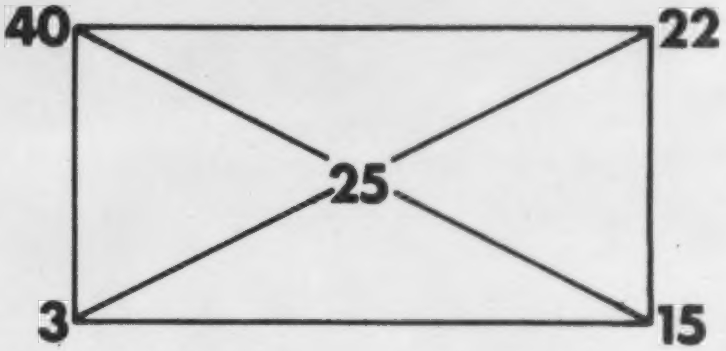
5. The two answers derived at the right-hand corners give the ratios of each material to use in the mixture.

6. In the example above, 1.5 pounds or parts of the 30% milk fat material would be mixed with 25.5 pounds or parts of the 3 % milk fat material to obtain a mixture containing 4.5% milk fat.

Standardizing Dairy Arithmetic
(Information Sheet continued)

Another example:

How much 3 percent milk must be added to 40 percent cream to reduce the cream to 25 percent?



From the square we find that 22 pounds of 40 percent cream should be mixed with 15 pounds of 3 percent milk to reduce the cream to 25 percent.

Assignment Sheet
for
MILK PROCESSING PLANT EMPLOYEE

UNIT: Milk Quality and Control

TOPIC: Grades of Cream

OBJECTIVE: To learn the standards for the grades of cream.

REFERENCES:

Required:

1. Manual for Milk Plant Operators, Milk Industry Foundation, p. 895
2. Information Sheet, "Grades of Cream"

QUESTIONS OR ACTIVITIES:

1. What are the three grades of cream and their fat requirement?
2. What is "gravity-separated" cream?
3. How is "plastic cream" prepared and what is its fat content?
4. What is the fat content of half-and-half?
5. Why is the cream line important to the consumer market?
6. What is the cream plug?
7. What additive is used to reduce feathering of homogenized cream?
8. How does the consumer judge the quality of cream?
9. What is the kind of gas used in pressurized containers of whipping cream?
10. What is the increase in yields from whipping cream in pressurized containers?
11. How is sterilized cream produced?
12. What is manufacturing cream and its use?

Information Sheet
on
GRADES OF CREAM

The three grades of cream, (a) light coffee or table cream, (b) light whipping, and (c) heavy whipping or pastry cream, vary according to the percent of fat in the sample of cream. Light coffee of table cream contains 18 to 30 % fat, light whipping cream contains 30 to 36% fat, and heavy whipping or pastry cream contains at least 36% fat.

Cream, fat content average of 20-22%, that naturally rises to the surface of milk is known as gravity-separated cream.

It is possible to prepare a cream with a fat content of 65 to 85% with a special type of cream separator. This cream is known as plastic cream.

Half and half is a mixture of milk and cream containing from 10 to 12% milk fat. Half and half is homogenized.

Because unhomogenized milk that has a deep layer of cream, cream line, has a better sale value, careful attention is given to not lowering the cream line. During pasteurization, milk is not heated above 145 degrees F. or 163 degrees F. in high temperature short-time pasteurization, because higher temperatures tend to lower the cream line.

The thick layer of large fat globules containing from 60 to 80% fat often found on top of a bottle of milk or cream is called the cream plug.

Feathering is a process whereby small feathery flakes of cream coagulate and float upon the surface of hot drinks such as coffee. Feathering is more apt to occur if homogenized or very thick cream is used, if the drink is made with hard water, or if the cream is slightly sour. It has been found that 2 to 5 ounces of sodium citrate added to 1000 pounds of cream, stabilizes the cream against feathering.

One lot of cream may have a different viscosity, or thickness, from another lot of cream, although both lots have the same fat content. Usually an increase in viscosity means an increase in fat content. Most consumers judge the quality of cream by its appearance--thick or thin; therefore, creameries try to produce cream with a high viscosity due to their processing procedures.

When cream is placed in a container under high pressure with carbon dioxide or nitrous oxide gas it is referred to as aerated cream. Aerated cream is not highly popular because it is too fluffy and consequently not similar to whipped cream.

Grades of Cream
(Information Sheet continued)

Aerated cream yields from 6 to 8 times the original volume of the cream placed in the container.

Until recently being able to produce sterilized cream has been unsuccessful due to its high fat content. By employing new techniques, it is now possible to can or bottle sterilized cream that will maintain its flavor for up to two years.

To prepare sterilized cream, the cream must have a fat content of 18 to 30% and be low in acidity--not over 0.14 to 0.15%. A gelatinous gum obtained from seaweed, 0.10 to 0.30% sodium alginate, is added to prevent coagulation.

Sterilization may be accomplished in two ways (a) flash pasteurization at a temperature of 280-300 degrees F., or (b) heating to 260-280 degrees F. for four minutes by adding steam under high pressure. Cream is then homogenized twice. First, it is homogenized at 2000 pounds of pressure and then homogenized at 500 pounds of pressure. The viscosity of the cream is maintained by controlling the pressures.

Much of the cream used in making butter, ice cream, some varieties of cheese, aerated cream, and other products is classified as manufacturing cream. Manufacturing cream usually does not come up to the standards for home use and is not usually obtained from Grade A milk.

Cells, bacteria, and dirt from milk collect on the walls of the separation drum and are referred to as separation slime.

Assignment Sheet
for
MILK PROCESSING PLANT EMPLOYEE

UNIT: Milk Processing Equipment

TOPIC Equipment Layout

OBJECTIVE To learn the fundamentals and importance of proper layout of plant equipment

REFERENCES.
Required
Manual for Milk Plant Operators, Milk Industry Foundation, pp. 224-231

QUESTIONS OR ACTIVITIES

1. What is usually the key to overall plant operation?
2. The methods of packaging are influenced by what?
3. What determines the sizes and rates of processing equipment?
4. What is the objective of a layout in a plant?
5. List the 3 basic flow plans
6. Why is the laboratory usually located near the receiving room?
7. What may determine whether cylindrical or rectangular storage tanks are used?
8. Processing area arrangement should permit what?
9. Access to the building on two or three sides reduces what?
10. Layout is subject to what 3 general restrictions?

Assignment Sheet
for
MILK PROCESSING PLANT EMPLOYEE

UNIT: Milk Processing Equipment

TOPIC: Materials for Dairy Equipment

OBJECTIVE: To learn the importance of selecting and using the proper metals for dairy equipment.

REFERENCES:
Required:
Manual for Milk Plant Operators, Milk Industry Foundation, pp. 232-257

QUESTIONS OR ACTIVITIES:

1. What are requirements for processing equipment?
2. What is the purpose of zinc or cadmium as a coating for mild steel?
3. What metal is the most satisfactory in meeting requirements of metals for contacting milk and products?
4. What are disadvantages of tinned copper for product contacting surfaces?
5. How is pure nickel or chromium-plated nickel used?
6. What is the most common use of tin?
7. What are two disadvantages of aluminum in processing equipment?
8. What type of solders are preferred for dairy equipment?
9. What is meant by 18-8 stainless steel?
10. Why should steel wool never be used in cleaning stainless steel?
11. Typical applications for plastics in dairy processing equipment can be divided into what two categories?

Assignment Sheet
for
MILK PROCESSING PLANT EMPLOYEE

UNIT: Milk Processing Equipment

TOPIC: Sanitary Pipe and Fittings

OBJECTIVE: To learn the fundamentals of installing and using the various types of sanitary pipe and fittings

REFERENCES:
Required:
Manual for Milk Plant Operators, Milk Industry Foundation, pp. 258-270

QUESTIONS OR ACTIVITIES:

1. Upon what does the size of piping depend?
2. Why is proper support of pipe lines necessary?
3. At what intervals should straight runs of piping be supported?
4. Improperly handled cleaning solutions can cause what damage to stainless steel piping?
5. What is one of the most important advantages of welded pipe lines?
6. What is probably the most important advantage of glass piping?
7. Where is plastic tubing used in the processing industry?
8. List the types of sanitary fittings.
9. What type of threaded fitting is recommended for vacuum lines?
10. Name the types of actuators that are available in air-operated valves.

Assignment Sheet
for
MILK PROCESSING PLANT EMPLOYEE

UNIT: Milk Processing Equipment

TOPIC: Sanitary Pumps

OBJECTIVES: To learn the types of sanitary pumps, their use, care, and maintenance.

REFERENCES:
Required:
Manual for Milk Plant Operators, Milk Industry Foundation, pp. 271-292

QUESTIONS OR ACTIVITIES:

1. For what are sanitary pumps used in the milk plant?
2. Name the two kinds of sanitary pumps available for use in the milk plant.
3. What is the principle of operation of the Centrifugal pump?
4. What advantages do Centrifugal pumps have?
5. What are the types of positive displacement pumps?
6. Where are piston pumps usually used in the milk plant?
7. Describe the two types of gear pumps used in the milk plant?
8. Describe the operation of the impeller type of positive displacement pump.
9. What are two advantages of the impeller type of positive displacement pump for use in the milk plant?
10. How should positive displacement pumps be cleaned?
11. Why should cleaning solutions not be recirculated through the pump?
12. Why should pumps never be pried or hit with metal bars or wrenches?
13. Why are rubber rotor positive pumps very desirable for handling products?
14. What are the advantages of the flexible impeller pump?

Assignment Sheet
for
MILK PROCESSING PLANT EMPLOYEE

UNIT: Milk Processing Equipment

TOPIC: Receiving Equipment

OBJECTIVE: To become familiar with methods of receiving milk and the equipment used in processing plants.

REFERENCES:
Required:
Manual for Milk Plant Operators, Milk Industry Foundation, pp. 293-302

QUESTIONS OR ACTIVITIES:

1. What are two methods of receiving milk?
2. What were the revolutionary changes in equipment made from handling can milk to bulk milk?
3. Where is the quality inspection of bulk milk made?
4. How is the amount of bulk milk received determined?
5. How is bulk milk moved from the farm to the plant?
6. Why is a two-weight-tank system desirable in a tank weighing operation?
7. What are 5 things to consider when using weigh cans?
8. Why should the receiving tank have adequate capacity?
9. How are butterfat samples taken?
10. What are some important things to consider when selecting conveyors?

Assignment Sheet
for
MILK PROCESSING PLANT EMPLOYEE

UNIT: Milk Processing Equipment

TOPIC: Milk Tanks

OBJECTIVE: To learn the importance of bulk milk handling and storage, and to become familiar with the various types of bulk tanks.

REFERENCES:
Required:
Manual for Milk Plant Operators, Milk Industry Foundation, pp. 303-332

QUESTIONS OR ACTIVITIES:

1. What two services do bulk storage tanks provide the milk plant?
2. What does the basic milk storage tank consist of?
3. What type of stainless steel is used in bulk milk storage tanks and what degree of finish must the metal have?
4. What kind of insulation is used in the bulk storage tank?
5. Where is the milk sampling valve usually located?
6. Why are agitators necessary on the bulk milk storage tank?
7. Describe a "silo" type milk storage tank.
8. How is the "silo" type storage tank cleaned?
9. What are the two ways milk can be agitated in the "silo" type storage tank?
10. What are some of the problems involved in construction and design of "silo" type storage tanks?
11. What are some of the problems of venting "silo" type tanks?
12. What are the results of overfilling a "silo" type storage tank?
13. At what temperature should milk be stored in the storage tank?

Assignment Sheet
for
MILK PROCESSING PLANT EMPLOYEE

UNIT: Milk Processing Equipment

TOPIC: Filters and Clarifiers

OBJECTIVES: To learn the principles of operation, use, care, and maintenance of filters and clarifiers.

REFERENCES:

Required:

Manual for Milk Plant Operators, Milk Industry Foundation, pp. 333-337

QUESTIONS OR ACTIVITIES:

1. What is the purpose of using filters in the milk storage operation?
2. Why is it important to remove leucocytes?
3. How are leucocytes removed from milk?
4. What are the two general types of filters used in the filtering process?
5. Why should the pressure on the milk line be kept under 10 pounds?
6. Why is it good to install two filters in a line with a by-pass?
7. What is the principle of operation of the clarifiers?
8. What is the length of time a clarifier may be used on cold milk? Warm milk?
9. A self-cleaning clarifier was introduced in ________________.
10. What is the capacity in pounds of milk which the clarifier can clean per hour?
11. What is the average amount of slime discharge per 2 hours of running?
12. What types of lubricants should be used on clarifiers?

Assignment Sheet
for
MILK PROCESSING PLANT EMPLOYEE

UNIT: Milk Processing Equipment

TOPIC: Separators and Homogenizers

OBJECTIVES: To learn the principles of operation of separators and homogenizers and the steps in using, caring for, and maintaining them.

REFERENCES:
Required:
Manual for Milk Plant Operators, Milk Industry Foundation, pp. 337-356

QUESTIONS OR ACTIVITIES:

1. What is the difference between clarifiers and separators?
2. What are the two general types of separators?
3. To what temperature should cooled milk be heated for warm separation?
4. To what percent fat by the Babcock test should skimming be done?
5. What is the capacity of the self cleaning separator per hour?
6. At what temperature does the cold milk separator operate?
7. To what percent fat will the cold milk separate skim milk?
8. Why may it be necessary to heat milk to 45 - 50°F. if it has been cooled over 36 to 48 hours?
9. What is the function of the standardizing clarifier?
10. What are the basic locations of the standardizing clarifier in the milk plant?
11. What is the purpose of the tri-process or all-purpose centrifugal?
12. What are homogenizers designed to do?
13. How is the pressure commonly known as "the homogenizing pressure" developed?
14. What is the range in size of fat globules before homogenization?
15. What are the steps for starting a homogenizer?
16. What are the procedures for operation of the homogenizer?
17. What is the procedure for closing down the homogenizer?
18. What are the problems in operation of the homogenizer?

Assignment Sheet
for
MILK PROCESSING PLANT EMPLOYEE

UNIT: Milk Processing Equipment

TOPIC: Heating, Holding, and Cooling Equipment

OBJECTIVES: To become familiar with the types, uses, and operation of heating, holding, and cooling equipment.

REFERENCES:
Required:
Manual for Milk Plant Operators, Milk Industry Foundation, pp. 357-375

QUESTIONS OR ACTIVITIES:

1. What are the five major types of heat and cooling exchangers?
2. Name the principal types of continuous-flow heat exchangers?
3. What type of metal is used in the flow coils of heat exchangers?
4. What is the principle of operation of the continuous-flow heat exchangers?
5. What principle of operation allows the use of high-temperature in the temperature-short time pasteurizer?
6. What is the required temperature for high temperature-short time pasteurizing?
7. What advantage does steam heating and vacuum treating have on the consumer market?
8. How is milk cooled after the steam heating process?
9. Under what conditions is the Batch method of pasteurizing practical?
10. What is the operating temperature of the ultra-high temperature pasteurizer?

Assignment Sheet
for
MILK PROCESSING PLANT EMPLOYEE

UNIT: Milk Processing Equipment

TOPIC: Sanitary Thermometers and Gauges

OBJECTIVES: To study the various types of measuring instruments and controls and their principles of operation.

REFERENCES:
Required:
Manual for Milk Plant Operators, Milk Industry Foundation, pp. 376-394

QUESTIONS OR ACTIVITIES:

1. What is the reason for using instruments and controls in the milk plant operation?
2. What is the definition of an instrument?
3. What are the various kinds of recorders available for use in the milk plant?
4. What are the various kinds of controls available for use in the milk plant?
5. What are the seven kinds of temperature sensing devices used in the milk plant?
6. What are the uses for pressure gauges in the milk plant?
7. What are the two types of sanitary gauges used in the milk plant?
8. How are pressure gauges usually calibrated?
9. What are manometers used to measure?
10. What is the hydrostatic type level sensor used for?
11. What are the various kinds of flow measurement meters?
12. What are the three kinds of weight measurement devices?
13. What services do flow meters provide to the milk plant?

Assignment Sheet
for
MILK PROCESSING PLANT EMPLOYEE

UNIT: Milk Processing Equipment

TOPIC: Automatic Controls

OBJECTIVES: To learn the various types of automatic temperature and pressure controllers, and their use and operation.

REFERENCES:
Required:
Manual for Milk Plant Operators, Milk Industry Foundation, pp. 395-417

QUESTIONS OR ACTIVITIES:

1. What are the two general types of automatic temperature controls?
2. What is the method of action of the self-acting temperature control?
3. What are some general maintenance requirements of the self-acting temperature controls?
4. What are the two general types of air-operated diaphragm valves?
5. What are the general maintenance problems of air-operated valves when the valve stem has a jerky motion?
6. Where are the automatic temperature controls used?
7. What are the uses of the pressure control in the milk plant?
8. What are the routine maintenance checks of the HTST controls?

Assignment Sheet
for
MILK PROCESSING PLANT EMPLOYEE

UNIT: Milk Processing Equipment

TOPIC: Fillers and Sealers

OBJECTIVES: To become familiar with the types of fillers and sealers, their care, operation, and maintenance.

REFERENCES:
Required:
Manual for Milk Plant Operators, Milk Industry Foundation, pp. 443-466

QUESTIONS OR ACTIVITIES:

1. For what are fillers and sealers used in the milk plant?
2. What two general types of filler are used?
3. What are the six parts of the gravity flow filler?
4. How is the milk level kept constant in the bowl?
5. What is the limitation of the gravity flow filler?
6. Describe the operation of the vacuum-type filler.
7. What are the two types of paper container fillers available for use in the milk plant?
8. How many made-up quart containers can be stored in a 20' x 20' x 10' room?
9. With what are paper cartons usually coated?
10. What are some problems of handling filled cartons?
11. What are the basic divisions of the all-plastic package?
12. Can bottle filling machines be used for filling all-plastic continers?
13. In what size container can bulk, single-service containers for dairy products be produced?
14. What advantages do the bulk, single-service containers have?

Assignment Sheet
for
MILK PROCESSING PLANT EMPLOYEE

UNIT: Milk Processing Equipment

TOPIC: Conveyors

OBJECTIVES: To become familiar with the types of conveyors and case stackers, their use and maintenance, and safety practices.

REFERENCES:
Required:
Manual for Milk Plant Operators, Milk Industry Foundation, pp. 467-486

QUESTIONS OR ACTIVITIES:

1. What are the two general types of conveyors used for handling milk cartons?
2. What causes non-lubricated conveyors to frequently fail?
3. What do gravity conveyors generally carry?
4. To get best results from gravity conveyors, what are some important facts to consider?
5. What are the reasons for the use of power conveyors in the milk plant?
6. What are the various types of drag-chain conveyors used in the milk plant?
7. What are the three general types of drive units used on conveyors?
8. What are three types of conveyor systems?
9. What do marshalling or accumulating devices do in the milk plant?
10. What are some accessories to conveyors?
11. What parts of the conveyor system should be lubricated?
12. What kind of lubricant is best for use on conveyor chains?

# Assignment Sheet
for
MILK PROCESSING PLANT EMPLOYEE

UNIT: Milk Processing

TOPIC: Receiving, Filtering, and Clarifying Milk

OBJECTIVES: To learn important considerations in receiving, filtering, and clarifying milk.

REFERENCES:

Required:

1. Information Sheet, "Receiving, Filtering, and Clarifying Milk"
2. Manual for Milk Plant Operators, Milk Industry Foundation, pp. 293-296

QUESTIONS OR ACTIVITIES:

1. What are the two methods of receiving milk from the farm?
2. At what temperature must the milk be maintained during transportation?
3. What are the two types of receiving docks used for bulk tank delivery?
4. How is bulk milk taken from the transport truck?
5. Where is the bulk raw milk pumped to from the transport truck?
6. What is the reason for filtering milk on the receiving line?
7. What does an excess of dust and sediment in the milk sample indicate?
8. What do some milk plants use in place of filters?
9. Does the clarifier lower the bacterial count of milk?
10. What is a standardizing clarifier?

Information Sheet
on
RECEIVING, FILTERING, AND CLARIFYING MILK

Milk, even when produced under the most sanitary conditions, contains some dust or sediment. Milk that contains an excess of dust and sediment indicates collection under unsanitary conditions and is declared unfit for human consumption. Even milk that is free of visible sediment is not necessarily clean, because it may have been filtered upon collection. Removal of the sediment alone does not necessarily make the milk clean or safe.

Filtration is the process by which sediment is removed from milk. Filters made of cloth are placed in the pipeline and the foreign matter is caught in the filter. Since this method does not remove microorganisms, milk plants use a mechanical clarification system to remove foreign matter from milk. Clarifiers work on the principle of centrifugal cream separators but they are designed to remove dirt, body cells, and some bacteria, rather than cream.

Even though some bacteria are removed during clarification, it is not an efficient way to decrease microorganism content. In some ways it may tend to increase bacterial counts because the mechanical action of the centrifuge breaks up clumps of bacteria, allowing them to move individually through out the milk.

In many fluid milk plants, standardizing clarifiers are used. These machines clarify the milk and at the same time remove 0.1 percent to 2.0 percent of the cream. If standardization is not needed the machines can be set so that only clarification will occur.

Assignment Sheet
for
MILK PROCESSING PLANT EMPLOYEE

UNIT: Milk Processing

TOPIC: Common Pasteurization Methods

OBJECTIVE: To become familiar with the common methods of pasteurizing milk and milk products.

REFERENCES:
Required:
Manual for Milk Plant Operators, Milk Industry Foundation, pp. 596-606

QUESTIONS OR ACTIVITIES:

1. As applied to milk and its products, what does pasteurization mean?
2. What is the difference between slow pasteurization and flash pasteurization?
3. After pasteurization, at what temperature should the milk be stored?
4. What are the methods of pasteurization?
5. What is the temperature and time range on UHT pasteurization?
6. What is the reason for sterilization of milk?

Assignment Sheet
for
MILK PROCESSING PLANT EMPLOYEE

UNIT: Milk Processing

TOPIC: Other Methods of Pasteurization

OBJECTIVE: To become familiar with the less-common methods of pasteurizing milk and milk products.

REFERENCES:
Required:
Information Sheet, "Other Methods of Pasteurization"

QUESTIONS OR ACTIVITIES:

1. What is the procedure for aseptic processing?
2. What temperature does the can reach in the aseptic processing procedure?
3. What are the two ways of pasteurization by radiation?
4. Are there any toxic potentials in irradiated milk processing?
5. What are some problems other than toxic potentials in irradiated milk?
6. What is the reason for a lack of use of pasteurization by ultraviolet light?
7. What does the ultraviolet light do to vitamin D content of the milk?
8. What is the reason for treating milk with hydrogen peroxide?
9. How can the hydrogen peroxide be removed from the milk before it is consumed?
10. What is the bactofuge method of pasteurization?
11. Where may the bactofuge have its best application?
12. How is milk pasteurized by electricity?
13. How is in-the-bottle pasteurization done?
14. What are the difficulties of in-the-bottle pasteurization?

Information Sheet
on
OTHER METHODS OF PASTEURIZATION

There are special types of pasteurization to fit specific situations. Aseptic or sterile processes utilize a procedure of high-temperature short-time sterilization on milk product containers to assure that they are sterile. The sterilization of the cans or packages allows the product to be stored without refrigeration. The cans are sterilized with superheated steam at a temperature up to 550 degrees F. The cans themselves reach a temperature of 425 degrees F., a little below the melting point of tin. Cold, sterile milk is then poured into the cans as they pass under a filling nozzle.

Sterilized milk is free of microorganisms and can be purchased in cans, glass bottles, and paper containers. It is of particular value in areas where refrigeration is not available.

Radiation is another process that has been considered as a substitute for pasteurization. There are two basic sources for the radiation used in milk sterilization. They are:

1. An electron beam from a machine--Van de Graaf generator
2. Gamma rays from a radioisotope, such as cobalt-60.

At the present time there are several obstacles to the use of radiation as a pasteurization process. They are:

1. Some studies have shown that irradiated milk is safe for consumption, but one researcher found that cooked, irradiated milk fed to rats produced heart lesions.
2. Irradiation produces off-flavor in milk.
3. With some milk products a color change may occur.
4. Some changes in texture may occur; irradiated milk jells in storage.
5. Irradiation is destructive to some vitamins, particularly thiamine, vitamin B_6, riboflavin, and ascorbic acid.

It should be noted that pasteurization can be done with much less radiation than is required for sterilization.

The use of ultraviolet light for the pasteurization of milk was developed in Germany during World War II. Milk is pumped through clear tubes in an area flooded with ultraviolet light. The heat from the lights raises the temperature of the milk about 9 degrees F. and causes a slight flavor change in the milk.

Other Methods of Pasteurization
(Information Sheet continued)

This change is claimed to be so slight that the average consumer would not notice it. The vitamin D content of milk is increased during exposure to the ultraviolet light, but as the process is slow and not adaptable to large operations, little information is available on it.

Much of the milk produced in areas outside the United States is of very poor quality from a bacterial viewpoint. This milk will spoil quickly unless some type of preservative that will inhibit bacterial growth is added to it. Hydrogen peroxide of a potable grade has been shown to work well as such a preservative. It is unique because pasteurization will destroy the peroxide before the milk is consumed. Although the use of hydrogen peroxide in fluid milk is prohibited in the United States, some milk products for export are treated with it. It is used in some European countries as a preservative and in Italy it can be used as a substitute for pasteurization. The main disadvantage to its use is in loss of nutrient value (about 6 percent).

Bactofugation is a method of removing bacteria from milk by a centrifugal process. A modified centrifuge removes about 1.5 percent of the skim milk and takes with it about 90 percent of the bacteria. The milk is then put into another bactofuge where about 90 percent of the remaining 10 percent of bacteria are removed. The 1.5 percent discharge from the second operation is returned to raw milk keeping milk loss to the original 1.5 percent. This process has application in areas where raw milk bacteria counts are very high. Bactofugation can be used to remove a large portion of the bacteria before pasteurization and greatly improve the final product.

The electropure system is a method of pasteurization using electricity for heat. A thin film of milk is forced between two walls which are actually flat carbon electrodes. The milk flowing between the walls completes the circuit and liberates heat directly into the milk. This is an effective method of pasteurization.

Pasteurization of milk in the bottle is not used in the United States, but has been used to some extent in England. Bottles are sterilized with superheated steam and then filled with milk heated to 147 degrees F. The filled and capped bottles are then submerged in 147 degrees F. water for 30 minutes. The disadvantage in this method is the added cost due to heating and cooling the bottles. There is also some doubt as to whether all the milk is heated to the proper temperature.

Uperisation is a Swiss method of pasteurization that utilizes two pre-heaters that raise the temperature of the milk to 173 degrees F. The milk is then pumped through a high pressure unit where the injection of steam raises its temperature to 302 degrees F. The heated milk is then cooled quickly to 176 degrees F. and the excess water from the steam is removed.

Assignment Sheet
for
MILK PROCESSING PLANT EMPLOYEE

UNIT: Milk Processing

TOPIC: Homogenization of Milk

OBJECTIVES: To learn the principles of and the steps in homogenizing milk.

REFERENCES:

Required:

Manual for Milk Plant Operators, Milk Industry Foundation, pp. 608-612

QUESTIONS OR ACTIVITIES:

1. What is homogenized milk?
2. Why is milk homogenized?
3. How is milk homogenized?
4. How much pressure is required to homogenize milk?
5. What are the advantages of homogenizing milk at a high heat?
6. What results if milk is homogenized raw or heated at less than 140^{o} F. ?
7. Why should homogenized milk be kept out of direct light?
8. What is the normal cause of sediment in homogenized milk?
9. When and how is the best way to remove the sediment from homogenized milk?
10. What does the second homogenization at a low pressure do?

Assignment Sheet
for
MILK PROCESSING PLANT EMPLOYEE

UNIT: Milk Processing

TOPIC: Filling Containers

OBJECTIVE: To learn the methods of filling containers and the important principles in using each common method.

REFERENCES:

Required:

Manual for Milk Plant Operators, Milk Industry Foundation, pp. 443-466

QUESTIONS OR ACTIVITIES:

1. What are two common methods of filling containers?
2. Which method of filling containers is the fastest?
3. Describe the filling operation of the gravity-flow filler.
4. Describe the filling operation of the vacuum filler.

Assignment Sheet
for
MILK PROCESSING PLANT EMPLOYEE

UNIT: Milk Processing

TOPIC: Milk Storage

OBJECTIVES: To learn the importance of cooling milk and the proper procedure in storing fluid milk.

REFERENCES:

Required:

Manual for Milk Plant Operators, Milk Industry Foundation, pp. 613

QUESTIONS OR ACTIVITIES:

1. How long can milk be kept between pasteurizing and consumption?
2. What causes the spoilage of milk when kept for several days?
3. Are these bacteria which cause spoilage of milk destroyed during the pasteurization process?
4. What are some ways of contaminating milk after pasteurization?
5. What are the results if storage temperatures rise above 45°F.?

Assignment Sheet
for
MILK PROCESSING PLANT EMPLOYEE

UNIT: By-Products and Specialties

TOPIC: Cultures-Fermented Milk Products

OBJECTIVES: To learn the principles and methods of manufacturing cultured milk products.

REFERENCES:

Required:

Manual for Milk Plant Operators, Milk Industry Foundation, pp. 614-628

QUESTIONS OR ACTIVITIES:

1. What are the cultured milk products produced at the milk plant?
2. Upon what does the production of cultured products depend?
3. From what are cultured milk products manufactured?
4. What do the bacterial starters produce?
5. How are starter cultures obtained for the fermentation process?
6. What are the essentials for making and maintaining good starter cultures?
7. What are the two products found in milk which inhibit the culturing process of the milk?
8. What causes "burst" cells and a slow or dead culture?
9. How do bacteriophage cause the slow or dead culture?

Assignment Sheet
for
MILK PROCESSING PLANT EMPLOYEE

UNIT: By-Products and Specialties

TOPIC: Skim and Buttermilk

OBJECTIVE: To learn the principles of processing skim and buttermilk.

REFERENCES:

Required:
1. Information Sheet, "Skim and Buttermilk"
2. Manual for Milk Plant Operators, Milk Industry Foundation, pp. 628-631

QUESTIONS OR ACTIVITIES:

1. How is skim milk defined?
2. What nutrients are taken from skim milk when the cream has been removed?
3. What are the uses of skim milk?
4. What percent protein does skim milk have?
5. What vitamins are sometimes used to fortify skim milk?
6. What portions of the milk does whey contain?
7. How is buttermilk defined?
8. What is the protein content of buttermilk?
9. How is churned buttermilk defined?
10. How is flake buttermilk made?

Information Sheet
on
SKIM AND BUTTERMILK

Genuine buttermilk is the liquid that remains after the fat is removed from milk or cream during the process of churning butter. Real buttermilk does not differ materially from skim milk. Genuine buttermilk has about the same nutritive value of milk except for much lower contents of fat and vitamin A. The following chart gives the average composition of buttermilk.

	From Sweet Cream	From Sour Cream
Water	90.83%	91.30%
Protein	3.45	3.40
Fat	0.55	0.65
Lactose	4.40	3.40
Ash	0.73	0.65
Lactic Acid	0.04	0.60

Skim milk is that portion of milk remaining after the cream has been extracted. In the past, skim milk was thought to be undesirable for human consumption because of low food value. This is not true; skim milk contains the same nutrients as whole milk except for fat and the vitamins associated with fat. When these deficiencies are replaced by other foods in the diet, skim milk is a very good food. Skim milk is used in the manufacture of casein, milk sugar, non-fat dry milk, and some varieties of cheese, especially cottage cheese. Much condensed skim milk is used by bakers, confectioners, and for the manufacture of ice cream. Condensed skim milk is made by the evaporation of skim milk to about one-third its original volume. The following tables give the composition of skim milk and condensed skim milk.

	Plain Skim Milk	Condensed Skim Milk
Water	90.42%	70.32%
Protein	3.68	11.83
Fat	0.10	0.37
Lactose	5.00	15.10
Ash	0.80	2.38

Skim milk is used by persons desiring a low amount of calories in their diet. The maximum fat content of skim milk varies from state-to-state but it is usually from 0.1 to 0.5 percent. Sometimes skim milk is fortified with vitamins A and D. A concentrated sour skim milk is used for animal and poultry feed.

When all the fat and casein are removed from milk, the remaining product is called whey. Whey is made up of albumin, lactose, and the mineral matter of milk. It is dried and used in infant foods and animal feeds. It is also used in the making of some cheeses, cheese spreads and in canned soup.

Assignment Sheet
for
MILK PROCESSING PLANT EMPLOYEE

UNIT: By-Product and Specialties

TOPIC: Special Milks and Drinks

OBJECTIVE: To become familiar with the procedures in processing special milks and drinks.

REFERENCES:

Required:

1. Information Sheet, "Special Milks and Drinks"
2. Manual for Milk Plant Operators, Milk Industry Foundation, pp. 659-672

QUESTIONS OR ACTIVITIES:

1. List the special products which the milk plant may produce?
2. What has caused the emphasis on fortified milk?
3. How is soft-curd milk produced?
4. What is the value of soft-curd milk?
5. What are the five ways of producing soft-curd milk in the plant?
6. What is the difference between chocolate milk and chocolate drink?
7. What products are added to milk to make chocolate milk?
8. What do markets look for in a desirable chocolate milk?
9. What is fresh concentrated milk?
10. What are the uses of sterilized milk?
11. How should frozen milk be processed?
12. What is the average life of frozen milk?
13. What is the keeping period of egg nog drink?
14. How much sodium is found in a quart of low-sodium milk?
15. What are the differences between human milk and cows' milk?
16. Why is goats' milk often recommended for infants' use?

Information Sheet
on
SPECIAL MILKS AND DRINKS

The composition and properties of human milk are quite different from cows' milk. Human milk is low in casein content and contains very little or none of the lower fatty acids, but it is higher in content of lactalbumin and lactose than cows' milk.

Cows' milk contains approximately three times the amount of protein found in human milk, and consequently infants are generally fed cows' milk that has been diluted with water.

Although human milk may be lacking in quality to fulfill all the infant's requirements, they can more readily assimilate their mother's milk than that from another source.

Goats' milk forms smaller and more flocculent curds and can be tolerated more easily in the human infant's stomach than can cows' milk; consequently, goats' milk is often recommended for invalids and infants.

Assignment Sheet
for
MILK PROCESSING PLANT EMPLOYEE

UNIT: By-Products and Specialties

TOPIC: Cream

OBJECTIVE: To learn the procedures in processing cream.

REFERENCES:

Required:

1. Manual for Milk Plant Operators, Milk Industry Foundation, pp. 607-608
2. Information Sheet, "Cream"

QUESTIONS OR ACTIVITIES:

1. What are the standard grades of cream?
2. Why does cream rise to the top of unhomogenized milk?
3. How is cream removed from milk at the milk plant?
4. How does the cream separator work?
5. What percent fat will be left in skim milk?
6. What are the smallest size fat globules that can be separated efficiently?
7. At what temperature should warm milk be separated? Cold milk?
8. At what temperature should cream be pasteurized?
9. What are the results of rough handling or handling practices that have a partial churning effect on the cream?

Information Sheet
on
CREAM

The three standard grades of cream are: light coffee or table cream, light whipping cream, and heavy whipping or pastry cream.

A centrifugal separator is used to separate cream, the portion of milk that has a high content of milk fat, from the skim milk portion of milk.

The bowl of the cream separator is rotated at a speed of 3,000 to 20,000 revolutions per minute.

Because cream is the lighter material of milk, it moves to the center of the centrifugal separator in which the bowl is being rotated. After the cream has moved to the center it flows out of the separator and the skim milk portion moves to the outside of the bowl. If the centrifugal separator is efficient, the skim milk should contain from 0.02% to 0.05% fat.

Due to the difference in sizes of the fat globules, not all of the milk fat can be separated from the skim milk. Fat globules smaller than two microns in diameter are difficult to separate.

Milk may either be separated when warm or cold. Most separators are used when milk is warmed to 90 degrees F, but milk can be satisfactorily separated when milk is cooled to 50-60 degrees F. The viscosity of cream is better when separated at 50 degrees F. than at a higher temperature.

Assignment Sheet
for
MILK PROCESSING PLANT EMPLOYEE

UNIT: By-Products and Specialties

TOPIC: Concentrated Milk Products

OBJECTIVE: To become familiar with the various forms of concentrated milk products and the procedures used in their manufacture.

REFERENCES:

Required:

1. Manual for Milk Plant Operators, Milk Industry Foundation, pp. 664-666
2. Information Sheet, "Concentrated Milk Products"

QUESTIONS OR ACTIVITIES:

1. What are the three classes of concentrated milk?
2. How is fresh concentrated milk produced?
3. How much of the water is removed from evaporated milk?
4. What is another term for evaporated milk?
5. Explain the procedures for manufacturing evaporated milk?
6. How is evaporated milk kept from coagulating during sterilization?
7. What kind of salt is added to keep the evaporated milk from coagulating?
8. When is evaporated milk sterilized?
9. What is the keeping time of sterilized, canned evaporated milk?
10. What is filled milk?
11. How is sweetened, condensed milk manufactured?

Information Sheet
on
CONCENTRATED MILK PRODUCTS

Concentrated milk is a milk product that is produced by evaporation of water from whole milk. The three classes of concentrated milk are fresh concentrated milk, evaporated milk, and sweetened condensed milk.

When preparing fresh concentrated milk, the volume of milk is reduced one third through evaporation of water. Before evaporation, at 100 degrees F., takes place the milk has been graded, standardized to about 3.5% fat content, pasteurized, homogenized and then cooled to about 125 degreesF. The milk is then pasteurized at about 180 degrees F. for 16 seconds and homogenized at 2500 pounds of pressure. After the evaporation process it is delivered to distributing plants where it is bottled after it has been pasteurized at 180 degrees F. for 20-25 seconds and cooled at 40 degrees F.

The fat content of fresh concentrated milk is adjusted so that the finished product will contain 10 to 10.5% fat.

Whole milk which has had about 60% of the water removed, by evaporation is evaporated milk or it may sometimes be referred to as "unsweetened condensed milk."

To prepare evaporated milk, raw milk is graded, weighed and clarified. The ratio of solids to fat is then standardized by addition of cream or skim milk. The milk is forewarmed to 190 to 210 degrees F. before being condensed to the required concentration in a vacuum pan. After evaporation 4000 pounds of pressure is used during the time the milk is being homogenized. The milk is then cooled and placed in storage tanks.

During sterilization the "salt balance" is adjusted as needed to prevent the milk from coagulating. The stabilizer salts used are disodium hydrogen phosphate, sodium citrate, or calcium chloride. The smallest amount of stabilizer that will be effective will be used.

The evaporated milk is sealed in cans and then is sterilized. The batch process or continuous sterilizers are used to sterilize the evaporated milk.

Although in time the fat will rise, sterilized, canned, evaporated milk will keep indefinitely.

Another type of milk product is filled milk. Coconut fat or other vegetable fat has replaced the milk fat in evaporated skim milk to produce filled milk.

Concentrated Milk Products
(Information Sheet continued)

The preservation of evaporated milk and sweetened condensed milk is different. In evaporated milk, heat is used in the can for preservation; sugar is the preservative used in sweetened condensed milk.

Steps used to manufacture sweetened condensed milk include: testing for quality, pasteurization, and forewarming at temperatures of 180 to 200 degrees F. for 15 to 30 minutes. Sucrose or a mixture of sucrose and dextrose of corn sugar syrups is added to the milk at a temperature about 190 degrees F., and the mixture is evaporated until there is 1 pound left of 2.5 pounds of mixture. The milk is held for 15 to 20 minutes at 80 to 86 degrees F. The mixture is then seeded with a small amount of dry skim milk powder to form a nucleus to develop small sugar crystals.

Assignment Sheet
for
MILK PROCESSING PLANT EMPLOYEE

UNIT: By-Products and Specialties

TOPIC: Ice Cream and Related Products

OBJECTIVE: To become familiar with the methods employed in producing the cream and related products.

REFERENCE:
Required:
Information Sheet, "Ice Cream and Related Products"

QUESTIONS OR ACTIVITIES:

1. What ingredients make up the ice cream mix?
2. What gives ice cream the rich flavor?
3. Where does the fat come from?
4. Where do serum solids come from?
5. What do the serum solids contribute to the product?
6. What are two reasons for adding sugar to the mix?
7. What are the steps in the manufacturing process of ice cream?
8. What temperature and time is required for ultra-high-heat pasteurization?
9. Why is the mix pumped into a vacuum vaporizing cylinder?
10. Why is the mix aged?
11. What are the two methods of freezing ice cream?
12. To what temperature is ice cream frozen?
13. Why are stabilizers added to ice cream mix?
14. Why are emulsifiers added to the ice cream mix?
15. Why is air whipped into the product during freezing?
16. What does the word "shrinkage" imply?
17. What causes "sandy ice cream"?
18. What is the basic difference between ice cream and mellorine?

Information Sheet
on
ICE CREAM AND RELATED PRODUCTS

Surveys have shown that ice cream is the most popular American dessert and it is therefore one of the most important milk products.

Ice cream is made from a group of basic ingredients known as the mix. Cream, milk, sugar, flavoring, an emulsifier, and sometimes egg yolk make up the ice cream mix. The rich flavor, body, and texture of ice cream is obtained from fat. The fat in ice cream comes from cream, milk, sweet butter, butter oil, or frozen cream. The milk solids-not-fat or serum solids come from milk, condensed skim milk, cream and non-fat dry milk and contribute to the flavor and texture of ice cream. Sugar is added to the mix to add sweetness and lower the freezing point so that the ice cream does not solidify in the freezer.

The manufacture of ice cream is begun by heating the liquid ingredients to about 110 degrees F. and then adding the sugar and other dry ingredients. After the addition of all the ingredients the mix is pasteurized. Pasteurization, one of the most important steps, can be accomplished by several methods. They are:

1. Batch Pasteurization - Temperature of 155 degrees F. is held for 30 minutes.

2. High-temperature Short-time Pasteurization (HTST) - Temperature of 175 degrees F. for 25 seconds.

3. Ultra-high-temperature Pasteurization - Temperature of 220 degrees F. for 30 seconds. This method has a beneficial effect on the flavor, stability, and texture of ice cream.

After pasteurization is completed, the mix is homogenized at a temperature between 160 and 200 degrees F. This is another essential step because it prevents the mix from churning in the freezer, reduces the time needed to age the mix, affects its viscosity or thickness, and improves the body and texture of the ice cream. After homogenization the mix is cooled to 30-40 degrees F.

The aging of the mix has been a common practice. The homogenized mix was held at a temperature of 32 to 40 degrees F. for four to twenty-four hours in order to permit clumping of the fat globules and to increase the viscosity of the mix. This process allows the mix to freeze faster and gives the ice cream better body and texture. It is of special value when the fat content is 15 percent or more and little attention is given other milk constituents. Modern methods of using stabilizers, emulsifiers, and mixes of high solids-not-fat have made a long aging period unnecessary. The mix can be held for a few hours or be sent directly to the freezer.

Ice cream freezers are of the following types:

1. Batch Freezer - In this freezer, brine at 0 to 10 degrees F. is circulated

Ice Cream and Related Products
(Information Sheet continued)

around the freezing cylinder containing the mix. Inside the cylinder a dasher turns about 200 revolutions a minute and scraper blades attached to it remove the frozen cream from the sides of the freezing cylinder. In seven to eight minutes the mix is frozen to 21 to 24 degrees F. and has reached the desired consistency. Air is then incorporated into the ice cream by a revolving beater. The air increases the volume of the ice cream from 80 to 100% and prevents it from freezing into a hard soggy mass. This process of whipping air into the mix is known as overrun.

2. Continuous Freezer - This freezer operates in much the same way as a batch freezer except that a continuous flow of mix and air are pumped through the freezer. This method gives a smooth, stiff ice cream in about 25 seconds. The ice cream is frozen to about 22 degrees F. The overrun is under better control using the continuous freezer than with the batch type.

Stabilizers are used extensively in the production of commercial ice cream. A stabilizer makes ice cream resistant to melting by forming a gel and gives it good body and texture. Care must be taken to keep the stabilizer content below 0.5 percent. Contents above this level tend to give ice cream a sticky or woolly body and make it too thick. Popular stabilizers include gelatin, preparations of vegetable gums, and pectin.

Emulsifiers also give ice cream good body and texture but they are added especially to make the product dry and stiff, and to reduce the whipping time. Added milk-solids-not-fat and soluble caseinates act as emulsifiers and stabilizers. Egg yolks are popular emulsifiers along with the mono- and diglycerides of edible fatty acids.

Shrinkage involves a loss of air and decrease in volume of ice cream, but it is not a serious problem in modern production. Shrinkage can be caused by excessive original overrun, improper storage temperature, low serum solids content, presence of free fatty acids in milk fat, and exposure to dry ice vapors. Packaging in containers, one-half gallon or smaller tends to decrease shrinkage because a smaller amount of air escapes during the packaging process.

One of the most common defects found in commercial ice cream is known as sandy ice cream. It is caused by the crystallization of milk sugar. When the milk sugar content of ice cream is higher than 11 percent, the tendency toward crystallization is much greater. Melting and refreezing is also a common cause of sandy ice cream. The seeding of the mix with finely divided lactose just before freezing is a good preventative measure.

The sale of imitation ice cream or Mellorine, has greatly increased in recent years. Mellorine is similar in composition to ice cream except that it is made with vegetable fat. It is usually made in ice cream plants since the same equipment can be used in the manufacturing process.

Assignment Sheet
for
MILK PROCESSING PLANT EMPLOYEE

UNIT: By-Products and Specialties

TOPIC: Dry Milk Products

OBJECTIVE: To learn the methods and principles of drying milk and milk products.

REFERENCES:
Required:
Information Sheet, "Dry Milk Products"

QUESTIONS OR ACTIVITIES:

1. What are the two methods of producing dry milk?
2. What is the reason for producing dry milk?
3. What was the first successful dry milk produced?
4. What are the two types of drum or roller driers used for drying milk?
5. Describe the operation of the drum or roller driers?
6. What is the drying time and temperature of the drum process of drying milk?
7. What is the procedure for spray drying milk?
8. How good are the keeping qualities of dry whole milk?
9. What percent milk fat does dry cream have if it was 18% milk fat cream?
10. Why is dry skim milk referred to as non-fat dry milk?
11. Why is dry buttermilk held in a bin for one day after it is dried?
12. What are the two steps involved in manufacturing malted milk?
13. From what is malt made?

Information Sheet
on
DRY MILK PRODUCTS

Drying is one of the oldest processes for preserving food stuffs. The first commercially successful dry milk product was malted milk which was first manufactured in 1883. Dry milk products make it possible to distribute dairy products in areas having no dairy industry or where economic conditions put fresh milk out of the reach of many.

There are two basic processes used in the production of dry milk. They are:

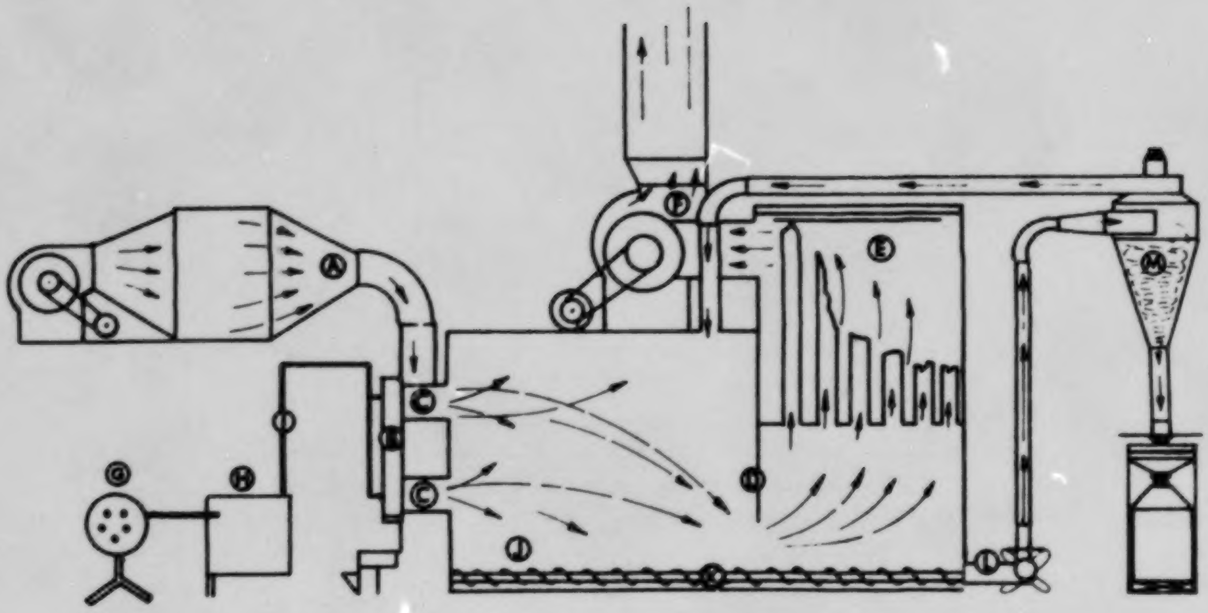
1. Drum or Roller Drying - These machines are either the open type or the vacuum type. The open type has two steel drums or rollers that dip into a trough that contains the milk to be dried. The drums are heated internally to 200-300 degrees F. with steam or hot water and are capable of drying 1000 to 6000 pounds of milk per hour. The milk is condensed before it enters the dryer so that the drying process will be faster.

   The vacuum drum dryers have the rollers enclosed in a chamber from which the air is with drawn. This permits the milk to be dried at a much lower temperature (212 degrees F.) than it can be dried with the use of the open dryer. As the drums rotate, they pick up a thin film of milk which is dried in one complete revolution of the drum (6 to 30 seconds depending upon the degree the milk has been condensed before processing). The dried milk is scraped off the drum in a thin sheet by knives or scrapers and falls into a bin. The dried product is then ground into a fine powder.

   The roller process is normally used for the drying of skim milk, whey, or buttermilk that is to be used in animal feed. The open process gives a more soluble product due to the high drying temperatures used.

2. Spray Drying - This process is used more frequently than is drum or roller drying. Almost all whole milk and about 80 percent of the nonfat dry milk is dried using the spray method. The following illustration shows the flow of the milk through the dryer.

Dry Milk Products
(Information Sheet continued)



Heated filtered air is blown through duct A through distributing head B into the drying chamber J. The milk to be dried is preheated at G and pumped at high pressure through the spray nozzles located in air inlets, C. The fine spray of milk is dried by the hot air and falls to the floor of the drying chamber J and is removed from the dryer by the conveyor screw K. The dried milk continues through the chamber outlet L where it is picked up and carried to the collector M. In the collector it is air-cooled, sifted and readied for packaging. Any powder that does not fall to the floor of the drying chamber is carried by the hot air past the baffle D to filter bags E where it is caught and automatically shaken to the floor at intervals. Dry milk made by this process forms tiny, hollow, spheres that are very soluble. The capacities of spray dryers vary from 150 to 5000 pounds per hour according to their size.

The following types of dried milk products are commonly produced:

1. Dry Whole Milk - The product is manufactured by the spray process and

despite many attempts to improve it, it has limited keeping qualities. Antioxidants such as nitrogen and carbon dioxide have been slightly successful in delaying spoilage but for the most part attempts at long storage periods have failed. Dry whole milk is used by bakers in the manufacture of milk chocolate and it is packaged in small containers for household use.

2. Dry Cream - The spray process can also be used to dry cream. The result is a light, cream-colored, somewhat flaky powder that is used by bakers, confectioners and chocolate manufacturers. When cream of 18 percent fat content is dried it will produce dry cream which contains about 72 percent milk fat.

3. Non-fat Dry Milk - Since the term skim milk has unfavorable effects on consumers, the dairy industry refers to dry skim milk as non-fat dry milk. Bakers use non-fat dry milk made from skim milk that has been preheated to a temperature of 180-190 degrees F. (high-heat) for 30 minutes. Cheese and ice cream manufacturers use a product that has been pre-heated to a temperature of 160-170 degrees F. (low-heat). There are many foods on the market today that contain varying amounts of non-fat dry milk and the product can also be purchased in its pure form for household use. The household product is called instant non-fat dry milk because it has undergone a process that makes it very soluble in water. This process binds the individual powder particles together in durable clusters. Since the clusters are relatively large and porous water can penetrate them easily, causing them to disperse and dissolve.

4. Dry Buttermilk - The spray process can be used to produce dry buttermilk from sweet cream buttermilk but sour cream buttermilk is normally drum dried. Dry buttermilk is usually held in a bin for at least one day after drying. This permits further crystallization of the lactose particles which keeps the product from caking when it is packaged. Dry buttermilk is used by bakers, confectioners, and ice cream manufacturers.

5. Malted Milk - This product was the first commercially produced dry milk product in the United States. Malted milk manufacture involves two steps:
   a. Preparation of a malt extract
   b. Mixing and drying of the extract with milk

   Barley malt is normally employed but wheat malt is also used. Barley is malted by soaking it in water and allowing germination to proceed to the point at which its diastatic activity is at its highest point. Diastatic activity is a measure of the amount of the enzyme diastase present. This enzyme converts starch into sugar. The malt is then dried, mixed with wheat flour, crushed and mixed with hot water. The diastase converts the starch in the

Assignment Sheet
for
MILK PROCESSING PLANT EMPLOYEE

UNIT: By-Products and Specialties

TOPIC: Butter and Margarine

OBJECTIVE: To learn the principles and procedures in manufacturing butter and margarine.

REFERENCES:
Required:
Information Sheet, "Butter and Margarine"

QUESTIONS OR ACTIVITIES:

1. What substances compose butter?
2. What are the steps in manufacturing butter?
3. Describe the modern churn.
4. How long does it take to churn a drum of cream?
5. To what does the term "break" refer in the churning process?
6. What does the term "working of butter" mean?
7. Describe the Fritz process of manufacturing butter.
8. What does the term overrun in butter making mean?
9. What is responsible for the yellow color in butter?
10. How many calories are contained in a pound of butter?
11. What are the body characteristics which detract from the quality of the butter?
12. What causes some defects in butter?
13. At what temperature is butter stored?
14. How is margarine manufactured?

Information Sheet
on
BUTTER AND MARGARINE

The recorded history of butter dates back 3500 years. Early civilizations valued cows according to the amount of butter that could be made from their milk, and the Romans used it for medicine.

Butter is a mixture of milk fat, water, buttermilk, and usually a bit of salt and added color. The steps in the manufacture of butter are as follows:

1. Upon arrival at the plant the cream is graded for quality, and if sour, it is neutralized by the addition of an alkaline compound such as sodium bicarbonate or lime.

2. The cream is then standarized to 30-33 percent fat. This is done because cream that is too low in fat content requires an excessive amount of time in the churning process and cream too high in fat content leaves some fat in the buttermilk after churning.

3. The standardized cream is filtered and pasteurized and some color may be added.

4. After pasteurization the milk is cooled to about 50 degrees F. and pumped into the churn.

The oldest form of dairy equipment is the butter churn. The modern churn consists of a stainless steel cylinder rotated on a horizontal axis. The cylinder contains shelves attached to its wall that continually raise the cream and then drop it. As the butter forms the continued raising and dropping gives it the necessary working or kneading that forces the butter granules into a compact mass.

To begin the churning operation the churn is filled about one-half full with cream. The churn is then rotated a few times to release the pressure caused by gases and air escaping from the cream. The cream is then churned until granules of butter, one-eighth to one-fourth inch in diameter, are formed (this usually takes 40-45 minutes). Toward the end of the churning process the butter begins to form quickly and is said to "break" as it separates from the buttermilk. The churn operator watches for this occurrence through a glass window in the side of the churn. The butter is then washed to remove the buttermilk from the granules. This is done to cut down on the possibility of off-flavors.

After the butter has been worked properly it is removed from the churn manually with a large wooden paddle, or by means of stainless steel rollers which push the butter into molds and at the same time, continue the working action.

Butter and Margarine
(Information Sheet continued)

Until the late 1930's butter was made by batch methods, but at that time continuous butter making processes were developed. The more popular methods of continuous butter making are:

1. Fritz Process - This process is used in Germany and France and uses cream of 40-45 percent fat. The cream enters a cooled cylinder at 40-45 degrees F. and is churned into butter in 1.5 seconds by high-speed dashers. An auger-like screw carries the butter out of the cylinder allowing the buttermilk to drain away and at the same time working the butter.

2. Alfa Process - This process is used in Germany and Sweden and uses cream with a fat content of 78-80 percent. By a combination of agitation and cooling in a cylinder called a "transmutator" the oil-in-water form of emulsion in cream is reversed to the water-in-oil form of butter.

3. Cherry-Burrell Process - This process, sometimes called "Gold'n Flow" is used in the United States and Canada. Raw cream cooled to 60-70 degrees F. is pumped into a high speed destabilizing unit where a perforated blade, travelling at high speed packs the fat globules together by mechanical force. The fat concentrate (88-94 percent) is then separated from the buttermilk and pasteurized at 200 degrees F. The concentrate is then cooled by evaporation to 110 degrees F. The cooled mixture is then dumped into large vats where it is standardized. After standardization it is chilled and worked into butter. Butter made by this process is somewhat light in color but its flavor and keeping qualities are excellent.

When butter is made, the weight of the finished product is always greater than the weight of the fat contained in the original cream. This excess weight is due to the presence of water, salt and curd in the butter and is called the overrun. Since butter must contain 80 percent fat, the maximum amount of butter that can be made from 100 pounds of milk fat is:

$$\frac{100}{80} \times 100 = 125 \text{ pounds}$$

This example shows an overrun of 25 percent. In actual practice this percentage is impossible to achieve. Modern, efficient creamery operators strive for an overrun of 23 percent.

The color of butter is due to its carotene content. Carotene is the yellow pigment found in green plants that animals convert to vitamin A. Butter color tends to vary from one dairy breed to another because some breeds (Jersey and Guernsey) can transfer more carotene from the feed to the milk. The color of butter tends to be lighter in the fall and winter because of the carotene-poor feeds available in the winter months. Since color change in butter is objectional to the consumer, the product is usually colored artifically in order to assure year round color uniformity.

The fat and vitamin content of butter are almost entirely responsible for its nutritional value. Butter is a heat or energy producing food that supplies about 3,400 calories per pound and its digestibility is about 97.8 percent. Besides normal creamery butter, the following butter products are also available:

1. Whey butter - Butter made from the whey recovered after the manufacture of cheese.

2. Whipped butter - Butter that has had its volume increased up to 50 percent by incorporating air into it.

3. Butter oil - This product is sometimes called clarified butter. Creamery butter is processed in such a way that the oil in butter is separated from the serum.

4. Dry milk fat - This product is the most concentrated form of milk fat available commercially. It is 99.8 percent fat and has a 0.1 percent moisture content. It can be stored for long periods of time in airtight containers.

The quality of butter depends to a great extent on the quality of the cream used in its manufacture. Defects in stability and flavor may also be caused by poor workmanship. United States grades for butter are based upon flavor characteristics and upon body, color, and salt characteristics. The following grades are used:

1. U. S. Grade AA, U. S. 93 Score, or 1st Grade

2. U. S. Grade A, U. S. 92 Score, or 2nd Grade

3. U. S. Grade B, U. S. 90 Score, or 3rd Grade

4. U. S. Grade C, or U. S. 89 Score

Body and color characteristics that may cause grade reduction are as follows:

1. Crumbly - Butter whose fat has a high melting point causes this defect. It is a result of feeding cows dry feed, such as cottonseed meal or holding cream at a low temperature.

2. Gummy - This defect is also caused by fats of high melting points.

3. Leaky - This butter defect is caused by failure to completely incorporate

moisture and uneven salt distribution due to improper working.

4. Mottling - This color defect is due to insufficient working of the churned butter. The flow of moisture towards the high salt concentrations causes irregular spots of color.

5. Streaks - This defect is also caused by insufficient working.

The following defects are commonly found in butter:

1. Contamination by Yeasts and Molds - Cream that has undergone a yeasty fermentation will produce butter that has an objectionable yeasty odor. Using clean equipment will minimize this defect.

2. Flavor Defects - Cream quality and length of storage before consumption have a great deal to do with butter flavor. An oxidized flavor, caused by a chemical change in the fat, is common in butter. Rancid butter flavors, caused by liberation of fatty acids from the fat, is also common.

3. Flavor Defects of Bacterial Origin - Flavors known as "barny" or "cowy" may be caused by using cream of high bacterial content. If bacterial decomposition has occurred a bitter flavor may result. Churns must be kept clean and sanitized to minimize defects of this type.

4. Surface Taint - This defect is associated with bacterial contamination. The bacterial source may be the cream or the water supply used to wash away the buttermilk. When surface taint is present, the butter begins to putrify on the surface, with gradual penetration into the body.

Butter for the retail trade is usually cut or "printed" into quarter, half, or one pound prints and wrapped in parchment. "Chiplets" weighing one-fourth to one-third ounce are made for the restaurant trade. Much butter is manufactured in the months of May to August because of the milk surplus at that time. It is put in cold storage at temperatures of 10 to 20 degrees F. and stored up to 9 months.

Margarine or oleomargarine is not a dairy product. It is composed in whole or part of fat other than milk fat together with water, skim milk, and salt.

The principal fats and oils used in the manufacture of margarine are soybean oil, corn oil, safflower seed oil, coconut oil, cottonseed oil, oleo oil, and neutral lard.

Margarine is manufactured by mixing fats and oils with ripened skim milk until a complete emulsion is obtained. Vegetable lecithin is usually added to facilitate the formation of the emulsion. The mixture is then chilled by passing it over steel cooling drums, or through a freezer. It is then churned by high-speed machines in much the same way as butter.

The calorie value of margarine is much the same as that of butter, but butter is slightly more digestible. Margarine is usually fortified with vitamins A and D and because of its cheap price, has almost replaced butter in the lower income consumer brackets.

Assignment Sheet
for
MILK PROCESSING PLANT EMPLOYEE

UNIT: By-Products and Specialties

TOPIC: Cheeses

OBJECTIVE: To learn the principles and procedures of manufacturing cheeses.

REFERENCES:
Required:
Information Sheet, "Cheeses"

QUESTIONS OR ACTIVITIES:

1. How many different kinds of cheeses may be listed according to processing procedures?
2. What are two other methods of classifying cheeses?
3. What percent moisture does soft cheese have?
4. What part of the milk is retained in the cheese?
5. What cheese is made from pasteurized milk?
6. What kind of cheeses are made from raw milk?
7. Why is a sixty day ripening set on raw milk cheese?
8. Why is hydrogen peroxide added to milk used for cheese manufacturing?
9. Explain the ripening process.
10. What does rennin do to milk?
11. Why is rennin added to the ripening milk?
12. Why is the method and way of removal of whey from the curd important?
13. Why is the manner in which the surface or rind is treated important?
14. What are some methods of adding salt to cheese?
15. What is the term given to fresh or unripened cheese?
16. What does the ripening process do to cheese?
17. What are some of the off-flavors detected in cheese?

Information Sheet
on
CHEESES

Cheese making was discovered before the time of recorded history. The first cheese is thought to have been produced in Arabia and from there the process spread over Asia and Europe. There are several Biblical references to cheese and the people of the Old Testament prized cheese as a valuable food.

Cheeses may be classified by several methods. There are about 800 names of cheeses but they all fall under 18 distinct processing types. They are:

- Brick
- Camembert
- Cheddar
- Cottage
- Cream
- Edam
- Gouda
- Hand
- Limburger
- Neufchatel
- Parmesan
- Provolone
- Romano
- Roquefort
- Sapsago
- Swiss
- Trappist
- Whey

Cheeses can also be classified by texture and the manner of ripening as shown in the following listing:

According to Texture

1. Very Hard
2. Hard
3. Semi-soft
4. Soft

By Manner of Ripening

1. By bacteria
2. By mold
3. By surface microorganisms
4. By a combination of 1-3
5. Unripened

The following table gives a classification of cheeses with examples.

1. Soft:
   a) Unripened:
      1. Low Fat--Cottage, Pot, Bakers'.
      2. High Fat--Cream, Neufchatel (as made in United States).

   b) Ripened: Bel Paese, Brie, Camembert, Cooked, Hand, Neufchatel (as made in France).

2. Semisoft:
   a) Ripened principally by bacteria: Brick, Munster.
   b) Ripened by bacteria and surface micro-organisms: Limburger, Port du Salut, Trappist.
   c) Ripened principally by blue mold in interior: Roquefort, Gorgonzola, Blue, Stilton, Wensleydale.

Cheeses
(Information Sheet continued)

3. Hard:
   a) Ripened by bacteria, without eyes: Cheddar, Granular, Caciocavallo.
   b) Ripened by bacteria, with eyes: Swiss, Emmentaler, Gruyere.

4. Very Hard (grating):
   a) Ripened by bacteria: Asiago old, Parmesan, Romano, Sapsago, Spalen.

5. Process Cheeses:
   Pasteurized, Cold-Pack, Related Products.

6. Whey Cheeses:
   Mysost, Primost, Ricotta.

Soft cheeses contain 45 to 80 percent moisture and are perishable. Semi-hard and hard cheeses contain 30 to 45 percent moisture and may be stored up to a year under favorable conditions. The ripening process for: soft cheeses is one to five months; for semi-hard cheeses--up to a year; for hard cheeses--up to two years.

The process of manufacturing cheese transforms milk into a more concentrated and less perishable product. The finished cheese contains most of the protein and milk fat but the more soluble milk constituents such as the milk sugar and mineral matter are lost in the whey.

Hard cheeses are usually manufactured from raw milk but in many cheese plants the use of pasteurized milk is increasing because it gives a more uniform product. Cottage and cream cheeses are made from pasteurized milk. Cheeses made from raw milk must be stored for 60 days before being offered for sale. Most pathogenic organisms are destroyed during the holding period.

Hydrogen peroxide is used as a bactericide in the manufacture of Cheddar, Colby, Washed Curd, Granular and Swiss cheese. After it has been given time to act it is removed from the milk with a catalase made from calf livers.

When milk begins to coagulate, it becomes very acid. Since coagulation is necessary in the cheese making process, cheese is ripened (coagulated) by the use of a starter. The starter, which is made up of desirable bacteria, causes the acidity to rise faster and the ripening process to be speeded up. The acidity developed tends to inhibit the growth of harmful bacteria and other micro-organisms.

Rennin, a milk curdling enzyme obtained from the stomach of suckling animals, is used for proper curd formation is cheese making. The commercial product, called rennet is added when the desired acidity in the ripening process is reached. The formation of the curd depends upon the coagulation of casein in the milk. Slow development of the curd may be due to too little rennet or the use of over-heated milk.

Two or three ounces of rennet diluted with one gallon of water will curdle about 1000 pounds of milk. After rennet addition the milk is stirred to distribute the rennet and then left undisturbed for the curd to form. After 30 to 40 minutes the milk is "set" with a firm curd.

The treatment of the curd depends upon the kind of cheese being made. The curd is left undisturbed for a definite time interval during which the curd acidity and body become firmer due to a decrease in whey content. Heating the curd favors these processes . If a soft cheese is being made the cheese is taken from the vat quickly and the whey is drained away. For other cheese varieties the curd is cut into small cubes and the whey is allowed to drain off. For Cheddar-type cheeses, the curd is heated in the whey and allowed to form a single mass, which is then cut into small pieces. The method used to remove the whey also depends on the kind of cheese being made.

The treatment of the surface or rind of the cheese influences its characteristics. Cheddar and Swiss cheese have a smooth rind because the curd is pressed while it is still warm and it is allowed to cure in such a way that moisture can evaporate from the surface. The surface of some cheeses are kept clean during the curing process while others are cured in a manner that encourages the growth of yeasts and molds on the rind.

Most cheeses have salt added during the manufacturing process. The salt acts as a preservative by controlling bacterial growth and also helps to draw the whey from the curd. The salt content of most cheeses varies from one percent in cottage to five percent in Parmesan and Roquefort. In Cheddar the salt is added to the milled curd; other varieties are salted by rubbing the surface with salt or by placing the cheese in a salt brine.

Cottage cheese, along with some others, is ready for consumption as soon as the curd is collected. Cheeses of this type are said to be "green" or "uncured". Their flavor is bland and the body is elastic and sometimes quite tough.

Hard cheeses must be further processed and held to develop their characteristics. The ripening or curing process brings about changes in body, texture, flavor, and sometimes color. These changes are due to:

1. Breakdown of protein

2. Hydrolysis of fat

Cheeses
(Information Sheet continued)

3. Fermentation of lactose, citrates, and other organic compounds.

These changes are brought about selectively by the enzymes, molds, bacteria, and yeasts in or on the cheese. The way in which the curd is handled and the cheese is stored influences these factors.

Each cheese variety has a characteristic flavor associated with it. Many times these flavors are overshadowed by defects in flavor. Some flavor defects are:

1. Unclean or Rancid - These flavors are often carried over from the milk used to make the cheese.

2. Bitter - This flavor is caused by the decomposition of proteins and usually becomes more noticeable as the cheese ages.

3. Fruit-like - This flavor is often caused by bacterial contamination from unclean milk or equipment. Excessive curd washing may also cause it.

Other flavor defects are acid, salty, and sulfide.

Assignment Sheet
for
MILK PROCESSING PLANT EMPLOYEE

UNIT: By-Products and Specialties

TOPIC: Cheddar and Cottage Cheese

OBJECTIVE: To learn the procedures used in manufacturing cheddar and cottage cheese.

REFERENCES:
Required:
1. Information Sheet, "Cheddar and Cottage Cheese"
2. Manual for Milk Plant Operators, Milk Industry Foundation, pp. 636-655

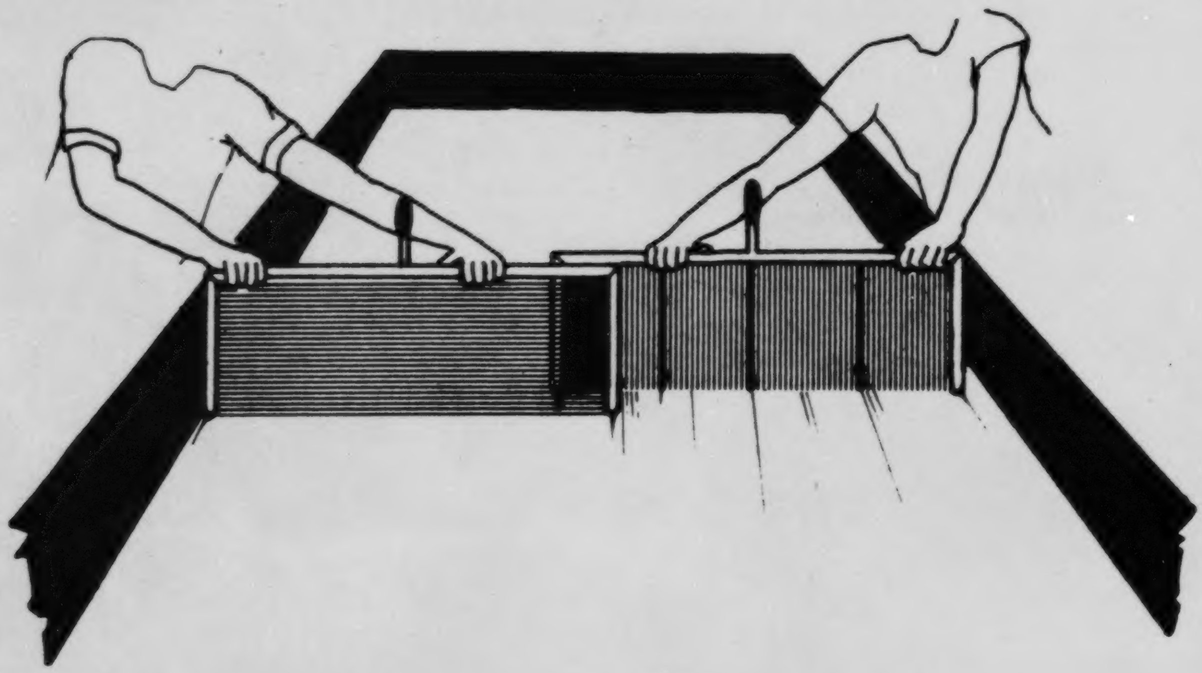
QUESTIONS OR ACTIVITIES:

1. What was the first factory made cheese?
2. Describe the process for manufacturing cheddar cheese.
3. What are some of the modified cheddar cheeses?
4. How many types of bacteria are predominant in cheddar cheese?
5. What may happen to cheddar cheese stored for eight months or more?
6. What are the two methods of making cottage cheese?
7. How long does the acid cured method take?
8. When is the whey drained off the curd to make cottage cheese?
9. Why is the cottage cheese curd washed after removal of the whey?
10. When is the cottage cheese ready for packaging?

Information Sheet
on
CHEDDAR AND COTTAGE CHEESE

Cheddar cheese was the first cheese made in factories. It is the most universally made cheese in English-speaking countries and several countries take credit for its existence. It is called American Cheese in the United States, Canadian Cheese in Canada and Cheddar Cheese in the British Commonwealth.

Cheddar is a hard cheese made, in most places, from raw cow's milk. In the United States about 75 percent of it is made from pasteurized milk. The manufacturing process is begun by heating the milk to 87 degrees F. and adding 0.5 to 2.5 percent of its volume of starter. The starter stimulates the growth of lactic acid forming organisms and when the proper acidity is reached—0.2 percent-rennet is added to coagulate the milk. The addition of 3 ounces of rennet for every 1000 pounds of milk coagulates the product in about 30 minutes.



Cheddar and Cottage Cheese
(Information Sheet continued)

After formation of the curd it is cut into small cubes (1/2 to 3/8 inch squares) with curd knives pulled the length of the cheese vat both horizontally and vertically. The curd cubes are left floating in the whey and the entire mass is stirred gently while the temperature is raised to 100 degrees F. The heating and stirring process develops proper body and acidity of the curd. The curd is then pushed to the sides of the vat in order to form a trench to allow drainage of the whey. This step, known as "ditching", is followed by the distinctive process in cheddar cheese making. It is called "cheddaring" and involves matting and piling the curd.

After draining away the whey, the curd is left undisturbed for 15 to 20 minutes. During this period it forms a single, spongy mass. This mass is cut into blocks 7 to 10 inches long which are stacked on top of one another to retain temperature and force out any remaining whey.

After completion of the "cheddaring" process the curd is put into a milling machine where it is cut into pieces 2 or 3 inches long and about one-half inch square. The cut curd is put back into the vat and evenly distributed along the vat bottom where one or two pounds of salt is added for each 100 pounds of curd. The curd is stirred to distribute the salt and the salt hardens and shrinks the curd particles. This promotes excess whey removal and also restricts microorganism and acidity development.

When the salt has dissolved the curd is cooled to 80 degrees F. and packed into cheesecloth lined hoops. The cheesecloth forms the "bandage" which remains on the cheese. The hoops are covered and put into presses that subject the cheese to gradually increasing pressure for 30 to 60 minutes. The cheese is then removed from the press and the bandage is smoothed and straightened. It is then returned to the press for 12 to 24 hours for the removal of excess moisture. The cheese is then removed from the hoop and held at 50 to 60 degrees F. for four days during which time the surface rind is formed. After drying it is dipped in paraffin or cheese wax an placed in a warehouse for curing. Most cheddar in the United States is cured for three months to a year at a temperature of 32 to 45 degrees F. The longer the curing process, the sharper and more pronounced the flavor of the cheese. Higher temperatures hasten flavor development, but increase the chances of flavor defects.

Cheddar cheese is modified in several ways to produce other types of cheeses. Among these are Colby Cheese, Granular, Pineapple, Monterey, High-moisture Jack, Washed or Soaked curd and Rindless. All these cheeses are made similarly to Cheddar with variations in the handling of the curd and the curing process.

There are at least six types of bacteria present in Cheddar cheese. They are:

1. S. Lactis - This organism is introduced into the cheese in the starter and predominates while the cheese is in the green stage.

Cheddar and Cottage Cheese
(Information Sheet continued)

2. Lactobacilli - These organisms begin to predominate as the cheese ripens. They include L. Casei, L. Plantarum, and L. Bulgaricus.

3. Cocci - These organisms are found in both good and poor grades of Cheddar.

One of the more common defects of Cheddar is found in cheese that has been stored for eight months or more. The oxidation of the fat causes development of a tallowy flavor and bleached areas on the rind. The exclusion of air from the cheese will prevent this defect.

Cottage cheese is one of the most popular varieties. It is a lactic acid, unripened, soft-curd cheese that is made from skim milk or non-fat dry milk. Cottage cheese is available in several styles. Among them are large curd, small curd, and creamed.

The manufacture of Cottage cheese can be accomplished with either an acid or a rennet curd. Either method produces curd ready for cutting and heating in 5 to 6 hours.

Acid-curd cheese allows curd formation without the use of rennet. When the curd is formed it is cut into small cubes, allowed to set for 15 minutes, and heated to 120 degrees F. over a period of 60 to 90 minutes.

Rennet-curd cheese is made by adding 1 milliliter of rennet to 1000 pounds of milk. About two hours after cutting the whey is drained off and the curd is washed several times to remove any acid, to increase curd firmness and to produce a milder flavored cheese.

Cottage cheese may be packaged directly after whey drainage but it is usually held in cold storage a 35 degrees F. for about two weeks.

Assignment Sheet
for
MILK PROCESSING PLANT EMPLOYEE

UNIT: By-Products and Specialties

TOPIC: Process and Swiss Cheese

OBJECTIVE: To learn the procedures used in manufacturing process and Swiss Cheese

REFERENCES:
Information Sheet, "Process and Swiss Cheese"

QUESTIONS OR ACTIVITIES:

1. What is processed cheese defined as?
2. What are some of the kinds of processed cheeses commonly used?
3. What is the procedure used im making processed cheese?
4. Why are emulsifiers added to processed cheese?
5. What is added to the processed cheese to control the acidity of the product?
6. What temperature must processed cheese be heated to during the processing of the cheese?
7. What is added to processed cheese to make it a processed cheese food?
8. How much moisture does processed cheese spreads have?
9. What is a visual characteristic of Swiss Cheese?
10. What is the characteristic flavor of Swiss Cheese?
11. What improvements in the final product are made by the clarification of the milk before processing for Swiss Cheese?
12. Where is the milk heated for processing into Swiss Cheese?
13. Why are starter cultures added to the milk when making Swiss Cheese?
14. What is added to the acid milk to make it coagulate?
15. What gas causes the eyes to develop in Swiss Cheese?

Information Sheet
on
PROCESS AND SWISS CHEESE

Process cheese is the product manufactured by mixing together different cheeses with the aid of an emulsifying agent and heat. Cheddar is the most commonly processed variety but Swiss, Brick, Limburger, and Camembert are also used.

The cheeses to be processed are run through a grinder and into a large cooker where water, coloring, and an emulsifier are added. The emulsifier prevents fat separation and helps to obtain desirable properties of melting and slicing. Harmless acids are added to control acidity.

The cheese is heated to 150 degrees F. for 30 seconds during which time it becomes plastic and flows readily. It is then moved to a filling machine and packaged for retail sale.

Process cheese food is process cheese with the addition of other food products such as milk, cream, skim milk, whey, fruits, vegetables, and meats. The cheese must constitute at least 51 percent of the finished product.

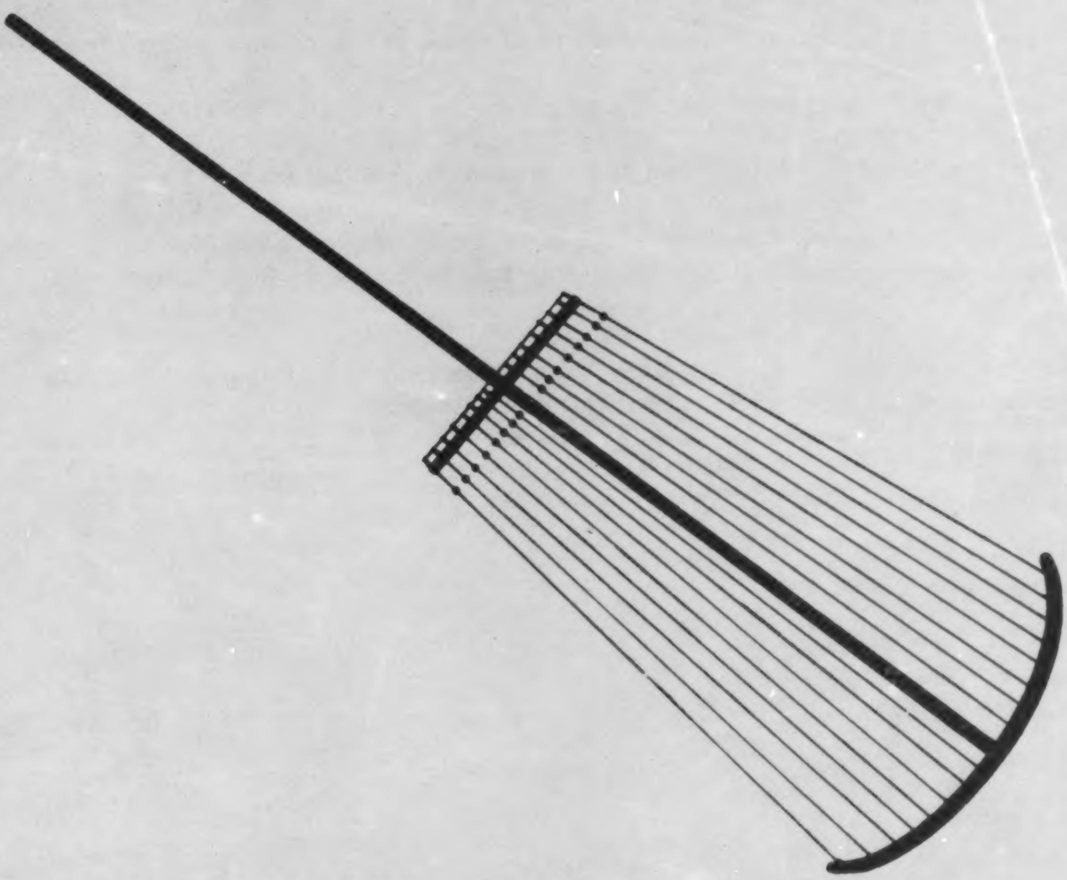
Process cheese spread differs from process cheese food in that it contains more moisture (44-60 percent) to make it spreadable. Sweetening agents such as sugar, maltose, or corn syrup may also be added.

Swiss cheese is a hard, pressed, rennet-curd cheese with a mild, sweet, nut-like flavor. The "eyes" or holes in Swiss cheese give it a recognizable visual characteristic. This cheese is very difficult to make. Its manufacture involves the use of special equipment and good quality milk that has been standardized to 3-3.5 percent fat content. Although pasteurization of the milk used has not proved uniformly successful, clarification at about 80 degrees F. does improve the formation of the eyes by reducing the "set" or number of eyes that develop.

To begin the manufacturing process the milk is placed in large, steam-heated, copper kettles where it is stirred slowly and starters are added. The starter contains organisms that form lactic and propionic acids. Rennet is added in amounts that coagulate the milk in about 30 minutes.

After coagulation the curd is cut into small granules with the use of knives called "Swiss Harps". It is then stirred and heated to about 128 degrees F.

Process and Swiss Cheese
(Information Sheet continued)



The removal of the curd from the whey involves a special process. First, a heavy cloth is placed over a hoop and the contents of the kettle are made to spin in a circular motion. The motion of the curd is quickly stopped by plunging a large paddle into the spinning mass. When this is done the mass of the curd collects in a spinning cone in the center of the kettle. The cloth covered hoop is then inserted beneath the cone and the curd is lifted out by means of a chain and pulley attached to the hoop.

The cheese is then pressed for about 24 hours to remove excess moisture and allow rind formation. The cheese is then moved to a room and salted for 2-3 days at a temperature of 53 degrees F. After salting it goes to a curing room where the temperature is 70 degrees F. and the humidity is 80-85 percent. In 6 to 10 days lactate-fermenting bacteria begin forming carbon dioxide which accumulates in the cheese causing eye formation. The gas moves through the cheese, collecting and forming bubbles in weak spots throughout the curd. The bubbles in turn become the eyes. Too little gas formation will result in "blind" cheese and too much will crack the curd and cause a defect known as glassy cheese.

The ripening process takes about 6 months during which time the eyes continue to develop. The cheese becomes softer as it ripens due to the action of enzymes. Under proper conditions, a well ripened Swiss cheese will keep for several years.

Good Swiss cheese has comparatively few eyes that are 1/2 to 1 1/2 inches in diameter. Many small holes or only large holes near the surface indicate improper development during the ripening process.

The cheese is made in large "wheels" that weigh from 60 to 200 pounds. A type of Swiss cheese made in the United States has neither rind nor eyes.

Assignment Sheet
for
MILK PROCESSING PLANT EMPLOYEE

UNIT: By-Products and Specialties

TOPIC: Other Varieties of Cheese

OBJECTIVE: To become familiar with the terminology and principles in manufacturing other varieties of cheeses.

REFERENCES:
Required:
Information Sheet, "Other Varieties of Cheese"

QUESTIONS OR ACTIVITIES:

1. How is blue cheese defined?
2. What is the origin of Brick Cheese?
3. What kind of milk is used to make brick cheese?
4. How is brick cheese made?
5. Where was Brie Cheese originated?
6. What is the odor and flavor of Brie Cheese?
7. What kind of mold grows on Camembert Cheese?
8. What causes the ripening of Camembert Cheese?
9. How is cold-pack cheese made?

Information Sheet
on
OTHER VARIETIES OF CHEESE

1. Blue Cheese - There are many names for Roquefort or Blue cheeses made in the United States.

2. Brick Cheese - This a semi-soft cheese of American origin. In flavor and texture Brick cheese falls between Limburger and Cheddar.

   The manufacture of Brick cheese is begun by setting fresh, pasteurized milk with a lactic acid starter and coagulating it with rennet. The curd is cut as in making Cheddar and heated to 115 degrees F. The whey is drained and the cheese is placed in square molds for further drainage. Bricks are often placed on the molds to hasten drainage.

   After 24 hours the molds are removed and the cheese is rubbed with salt and placed in a curing room at a temperature of 60 degrees F. and high humidity. After approximately two weeks into the curing process a reddish-brown mold begins growing on the surface of the cheese. After two weeks of mold growth the cheese is dried and dipped in paraffin. It is then wrapped in parchment paper and ripened for about two months.

3. Brie Cheese - This cheese is of French origin. It is a soft, mold-ripened, rennet cheese. After cutting and pressing of the curd, it is put in a dark, moist room for two to four weeks. During this time the cheese develops a soft body, sharp odor, and a characteristic flavor. Brie cheese is perishable and must be held under refrigeration.

4. Caciocavallo - This cheese originated in Italy. It is a drawn-curd cheese that is made from cow's milk curdled with rennet paste.

   To make Caciocavallo, cow's milk is curdled and the whey is drained off. The whey is then heated and put back with the curd. It is allowed to stay until it is placed in very hot water, when the cheese maker can stretch the curd into long, elastic fibers. These fibers are placed in a vat of hot water until they become plastic. The rope-like pieces are then shaped into figure-eights and allowed to cool. They are then salted and hung over poles in the curing room where the temperature is 62 degrees F. and the humidity is 85 percent. They are cured for 2 to 4 months for table use and a year or more for use in grated form.

5. Camembert Cheese - A French cheese, Camembert is made by setting cow's milk with a lactic acid starter and enough rennet to make a firm curd in about an hour. The curd is sliced, put in metal forms, and placed on reed mats for drainage. The curd dries to one-half its original moisture and develops

Other Varieties of Cheese
(Information Sheet continued)

mold growths of Penicillium Camembert, Geotricum Candidum, and Bacterium Linens. The mold growth forms a grayish-white layer on the surface of the cheese that later changes to a reddish color. A well ripened cheese has the texture of soft butter. The softness is caused by enzymes that act upon the protein of the cheese, ripening it by proteolytic action. This action begins on the surface and works to the center of the cheese.

6. Cold Pack Cheese - Also known as Club Cheese, this product is made by grinding and mixing together varieties of cheese without heat. Because the cheese is made without heat, pasteurized milk must be used in its manufacture or it must be held for at least 60 days at not less than 35 degrees F.

7. Coon Cheese - Named after its inventor, E. W. Coon, this cheese is a Cheddar cured at high temperatures (55-70 degrees F.) and a humidity of 95%. The product has a very sharp, tangy flavor and a crumbly body.

8. Cream Cheese - This soft unripened cheese is made from a milk and cream mixture in much the same way as Cottage Cheese.

9. Edam Cheese - This product is a hard, rennet curd cheese that is manufactured in much the same way as Cheddar Cheese except that the curd is not allowed to develop any rancidity nor is it cheddared or salted.

10. Feta Cheese - Feta is a type of pickled cheese made from ewe's milk.

11. Limburger Cheese - This is a soft, rennet-curd cheese that is ripened by high bacterial action. It has a strong odor and flavor due to the protein decomposition that takes place.

12. Pickled Cheese - Pickled or Brine-ripened cheeses are important in Europe. They are soft, bacteria-ripened cheeses that are rubbed heavily with salt or soaked in brine or salted whey for a week to a month. The salt acts as a preservative.

13. Roquefort Cheese - This cheese is a semi-hard, mold-ripened product that has a characteristic marbled, blue-green appearance. The genuine cheese is made from ewe's milk and is the only cheese of this type that is popular world-wide. It is made only in France.

14. Whey Cheese - Mysost and Ricotta are the two best known types of whey cheeses.

Assignment Sheet
for
MILK PROCESSING PLANT EMPLOYEE

UNIT: Plant Equipment Maintenance

TOPIC: Uses of Steam and Hot Water

OBJECTIVE: To determine the uses of hot water and steam.

REFERENCES:
Required:
Manual for Milk Plant Operators, Milk Industry Foundation, pp. 79-83

QUESTIONS OR ACTIVITIES:

1. Fo what is steam used in the milk plant?
2. How many pounds of steam are used to wash a milk can?
3. How is steam produced for use in the milk plant?
4. What is the most important consideration in selecting a steam boiler?
5. What is one Btu?

Assignment Sheet
for
MILK PROCESSING PLANT EMPLOYEE

UNIT: Plant Equipment Maintenance

TOPIC: Hot Water Requirements

OBJECTIVE: To learn the requirements for hot water in the dairy processing plant.

REFERENCES:

Required:

Manual for Milk Plant Operators, Milk Industry Foundation, pp. 104-108

QUESTIONS OR ACTIVITIES:

1. What are the principal uses of hot water in the milk plant?
2. Where is the most economical place to locate the hot water supply tank?
3. During what part of the day are the hot water requirements the greatest?
4. Why is hot water storage necessary?
5. How many gallons of hot water are required per wash basin per hour?
6. How many gallons of hot water are required for low pressure hose outlets per hour?
7. How is most hot water produced in the milk plant?

Assignment Sheet
for
MILK PROCESSING PLANT EMPLOYEE

UNIT: Plant Equipment Maintenance

TOPIC: Boilers

OBJECTIVE: To become familiar with the types of boilers and their care, operation, and maintenance.

REFERENCES:

Required:

Manual for Milk Plant Operators, Milk Industry Foundation, pp. 83-104

QUESTIONS OR ACTIVITIES:

1. What are two classes of boilers?
2. How is water heated in the water-tube type boiler?
3. How is water heated in the fire-tube type boiler?
4. What are the three ways heat is expended from the boiler furnace?
5. What determines boiler efficiency?
6. What are some things to do before filling a boiler for service?
7. Before starting the fire, what precautions should be taken?
8. What procedure should be taken when cutting-in a boiler?
9. What should be done if water level gauges show an unusual difference?
10. What should the plant "log" indicate about each safety valve?
11. What determines the frequency of boiler cleaning?
12. Why should oils not be allowed to get into the boiler?
13. How often should the fusible plug be replaced?
14. What kind of repairs can be made to the boiler or piping while operating?
15. What do "pock marks" indicate?
16. What is the best method of determining need for tube cleaning, nozzle cleaning, and other cleaning processes?
17. Why is it necessary to "treat" boiler feed water?
18. What determines the correction of the feed water?

Assignment Sheet
for
MILK PROCESSING PLANT EMPLOYEE

UNIT: Plant Equipment Maintenance

TOPIC: Water Sources and Conservation

OBJECTIVE: To learn the importance of the water source and the principles of water conservation.

REFERENCES:
Required:
Manual for Milk Plant Operators, Milk Industry Foundation, pp. 48-50

QUESTIONS OR ACTIVITIES:

1. What is an ideal water supply?
2. What are the original sources of water?
3. What happens to water as it forms and falls to earth?
4. What is the bulk of all water "hardness?"
5. What is usually the best source of water for the milk plant?
6. Under what conditions would a private water well be recommended?
7. Why is water conservation becoming important to industry?

Assignment Sheet
for
MILK PROCESSING PLANT EMPLOYEE

UNIT: Plant Equipment Maintenance

TOPIC: Water Impurities

OBJECTIVE: To determine the effect of water impurities on milk plant equipment.

REFERENCES:

Required:

Manual for Milk Plant Operators, Milk Industry Foundation, pp. 50-54

QUESTIONS OR ACTIVITIES:

1. Why is it necessary to analyze the water?
2. What determines the kind of cleaning compounds needed in the milk plant?
3. What is the Grade "A" Pasteurized Milk Ordinance requirement for water?
4. What may cause objectionable taste in water?
5. What may cause objectionable odor in water?
6. How can odor be removed from water?
7. How can suspended matter be removed?
8. What do excessive dissolved solids lead to?
9. Why are sulfide compounds undesirable in water?
10. What determines the degree of hardness in water?

Assignment Sheet
for
MILK PROCESSING PLANT EMPLOYEE

UNIT: Plant Equipment Maintenance

TOPIC: Filters, Chlorination, and Corrosion

OBJECTIVE: To learn the ways water impurities may be removed to protect the efficiency of the milk plant.

REFERENCES:
Required:
Manual for Milk Plant Operators, Milk Industry Foundation, pp. 55-65

QUESTIONS OR ACTIVITIES:

1. Why is it necessary to backwash the filter when the pressure difference becomes five pounds?
2. At what rate should the filter bed be washed?
3. What is the general rate of flow of the water filter?
4. What causes the formation of a "mud ball" in the filter sand?
5. What does a "polishing" filter do to the water?
6. What are the tube filters wound with in the "polishing" filter?
7. What is used to remove taste, odor, and chlorine from water?
8. How does activated carbon remove the odor and flavor from water?
9. Why is water chlorinated?
10. What are three forms of chlorine that can be added to water?
11. What are the chief factors causing corrosion in water cooling equipment?
12. How can gas be removed from water to prevent corrosion?

Assignment Sheet
for
MILK PROCESSING PLANT EMPLOYEE

UNIT: Plant Equipment Maintenance

TOPIC: Corrective Water Treatments

OBJECTIVE: To learn the correct ways to treat water for purification.

REFERENCES:
Required:
Manual for Milk Plant Operators, Milk Industry Foundation, pp. 68-78

QUESTIONS OR ACTIVITIES:

1. What determines the most economical treatment of water?
2. How hard should the water be for most efficient heat transfer in the boiler?
3. What is the advantage of chemical precipitation of hardness salts for softening water?
4. What material is most often used in the chemical softening of water?
5. What is the most effective and practical softening method for water?
6. What is the degree of hardness of zeolite softened water?
7. What is the bed arrangement in the zeolite filter?
8. Why is a brine solution slowly passed through the zeolite bed?
9. What does hydrogen zeolite remove from the water?
10. How is water dealkalized?

Assignment Sheet
for
MILK PROCESSING PLANT EMPLOYEE

UNIT: Plant Equipment Maintenance

TOPIC: Pumps and Piping

OBJECTIVE: To determine the types of pumps and pipe used in the milk plant and procedures for maintenance.

REFERENCES:

Required:

Manual for Milk Plant Operators, Milk Industry Foundation, pp. 108-112 and 113-124

QUESTIONS OR ACTIVITIES:

1. What are three classes of auxillary pumps used in the milk plant?
2. Why can the centrifugal pump handle dirty liquids well?
3. What are two types of turbine pumps?
4. How can high pressures be obtained using impeller pumps?
5. Why are rotary pumps limited to clear liquids or emulsions?
6. What will result if dirty liquids are pumped through a reciprocating pump?
7. What is the cause of pump cavitation?
8. What damage will result to a pump if pump cavitation is allowed to continue?
9. When are auxilliary pumps used in the milk plant?
10. What will provide long life and good service from the auxilliary pumps used in the milk plant?
11. What are the two kinds of pipe used in the milk plant?
12. How can heat classes be reduced when water is piped long distances?

Assignment Sheet
for
MILK PROCESSING PLANT EMPLOYEE

UNIT: Plant Equipment Maintenance

TOPIC: Air Compressors

OBJECTIVE: To learn the basic kinds of air compressors, their application, installation, and operation.

REFERENCES:
Required:
Manual for Milk Plant Operators, Milk Industry Foundation, pp. 124-133

QUESTIONS OR ACTIVITIES:

1. What are the types of air compressors?
2. What is the difference between single and multi-staged compressors?
3. Why are non-lubricated or oil-free compressors popular for dairy plant use?
4. Why are air storage tanks needed?
5. Why is a large air storage tank with a wide pressure range desirable?
6. Why are aftercoolers used on compressed air lines?
7. Where is air pressure used in the milk plant?
8. When compressed air comes in contact with the product, what kind of compressor is needed?
9. What are the maintenance requirements of an air compressor?

Assignment Sheet
for
MILK PROCESSING PLANT EMPLOYEE

UNIT: Electrical Power and Refrigeration

TOPIC: Terminology and Requirements

OBJECTIVES: To learn the requirements and terminology used in electrification and refrigeration.

REFERENCES:
Required:
Manual for Milk Plant Operators, Milk Industry Foundation, pp. 134-136, 145-146

QUESTIONS OR ACTIVITIES:

1. What is generally the best source of power for the milk plant?
2. What are some other sources of power?
3. What are the three main points when considering a source of electrical power?
4. Define the following electrical terms:
    - (a) Ampere
    - (b) Demand
    - (c) Kilowatt
    - (d) Kilowatt hour (kwh)
    - (e) Load
    - (f) Ohm
    - (g) Phase
    - (h) Volt
    - (i) Volt-ampere
    - (j) Watt
5. What four factors in the electrical contract will influence the type of electrical equipment in the milk plant?
6. What are some of the characteristics of the power supply?
7. Define the following refrigeration terms:
    - (a) British Thermal Unit
    - (b) Compression ratio
    - (c) Convection
    - (d) Flash gas
    - (e) Ice melting equivalent
    - (f) Latent heat
    - (g) Sensible heat
    - (h) Specific heat

Assignment Sheet
for
MILK PROCESSING PLANT EMPLOYEE

UNIT: Electrical Power and Refrigeration

TOPIC: Wiring Materials and Controls

OBJECTIVE: To learn the kinds of electrical conductors and electrical controls.

REFERENCES:

Required:

1. Manual for Milk Plant Operators, Milk Industry Foundation, p. 142
2. Information Sheet, "Wiring Materials and Controls"

QUESTIONS

1. What are the basic requirements of a well-planned wiring system?
2. What does the National Electric Code provide?
3. What label should all electrical equipment bear?
4. What is the purpose of control panels?
5. What is an electrical circuit?
6. What kind of insulation should general circuits have in the milk plant?
7. When should rigid conduit be used in the milk plant?
8. Why should all equipment be grounded?
9. For what are motor relays used?
10. Why should a time delay fuse be used in the motor circuit?

Information Sheet
on
WIRING MATERIALS AND CONTROLS

A. General Requirements of a Wiring System

1. All wiring materials and electrical equipment used should bear the "Underwriters' Laboratories, ind." (UL) label.

2. All wiring and installations should meet the minimum standards set by the National Electric Code and any local electrical code that applies. Such codes exist for the protection of lives and property.
    a. Local code requirements are usually greater than, or apply in addition to, the National Electric Code requirements.
    b. Some local codes require a licensed electrician to install the wiring system.
    c. Others require a wiring permit and most require inspection by local authorities before the system is energized.

3. The basic requirements of any well-planned wiring system are that it shall be safe, adequate, expandable, and efficient.

4. Only the first requirement, safety, will be achieved by compliance with the National Electric Code. The others depend on careful planning.

B. Control Panel

1. The fused distribution panel or circuit breaker panel should have a rating not less than the load to be carried. The total load should be computed in amperes. (amperes = watts - volts)

2. The conductors feeding or energizing the panel should be selected to carry the load (in amperes) safely and to provide adequate service to the house.
    a. Compute total load in amperes (amperes = watts - volts). Use Safety Table No. 1 for minimum wire size.
    b. Determine maximum load likely to be on at one time under normal operations (in amperes). Use Tables No. II, III, and IV to select wire size to maintain proper voltage for distance involved.

3. The number of circuit positions (fuses or breakers) will depend on size of building and equipment to be used.
    a. One position is needed per 120 volt circuit.
    b. Two positions are needed per 240 volt circuit.
    c. Each circuit should be fused separately.

Wiring Materials and Controls
(Information Sheet continued)

C. Number and Kind of Circuits

1. General lighting circuits should have a maximum of 8 outlets per circuit.

2. Outlet circuits (grounded type)
   a. General purpose circuits should have a maximum of 8 outlets per circuit.
   b. Motor circuits
      (1) Provide one 120 volt circuit for each two motors 1/3 hp and smaller.
      (2) Provide individual circuits for motors 1/2 hp and larger.
   c. Special purpose circuits
      (1) Individual 240 volt circuits should be provided for each heater.
      (2) Individual circuit should be had for pump motors if pumping system is needed.
      (3) Individual circuits for motors 1/2 hp and larger.
      (4) Individual circuit for electric hot water heater.

D. Size of Wire and Type of Wire

1. General purpose circuits
   a. Minimum wire size for general purpose circuits should be No. 14 with 15 ampere protection.
   b. No. 12 with 20 ampere protection is recommended for general purpose circuits.
   c. Underground feeder (UF), Romex, or TW in conduit is recommended in a building. Conductor with safety ground wire or grounded conduit system should be used.
   d. For distances over 30', larger wire sizes may be required to maintain proper voltage. The proper wire size can be determined from Tables II, III, and IV.

2. Special purpose circuits
   a. Determine proper wire size from Tables II, III, and IV, according to voltage, load in amperes, and distance involved.

E. Grounding Equipment

1. Proper electrical wiring and grounding will help to prevent electrical shock, excessive operating costs, and unsatisfactory operation of equipment.

Wiring Materials and Controls
(Information Sheet continued)

2. All outlet circuits should have safety grounded type outlets and a safety ground provided.
    a. Safety ground wire from the outlets should be attached to the neutral bar in the control panel.
    b. An approved grounded conduit system may be used as the safety ground.

3. All equipment should be properly grounded. If equipment does not have a three-prong (polarized) plug and three-wire cord to automatically ground the frame when plugged in, a wire should be attached from the metal case of the appliance to the neutral bar in the central panel.

4. The distribution panel should be properly grounded.
    a. Many local codes specify required grounding methods.
    b. In the absence of local code requirements, the panel can be grounded by clamping to a cold water line if it is a good ground.
    c. Supplement this ground by clamping to an 8' x 1/2" copper rod, 5/8" iron or steel rod, or 3/4" galvanized pipe. Top of rod or pipe should be at least 12" under soil surface.
    d. Grounding conductor to panel should be at least No. 6 copper.
    e. All connections should be made with approved ground connectors or ground clamps.

F. Circuit Installation

1. All installations should be made to meet the National Electric Code and any local code requirements.

2. Wiring diagrams of various common installations are included in this lesson.

G. Motor Protection

1. Unless motors have built-in thermal relay protection (Example: Thermoguard Type), they should be protected with a time delay device.

2. To properly protect a motor from too many amperes due to overload, worn bearings, short in windings, or low voltage, a time delay fuse (fusetron) or thermal relay switch should be used in the motor circuit.
    a. Fused outlets to plug in small motors and fused switches are available to use in protecting motors.
    b. A common fuse will not protect a motor because it cannot be fused closely enough.

c. In most cases, circuit breakers will not protect a motor because the smallest rating available is 15 amperes.

H. Electric Controls

1. Factors to consider in selecting controls include:
    - a. Type of power - voltage and phase
    - b. Amount of load - amperes and horsepower
    - c. Type of load - motors, lights, or heaters
    - d. Control function - safety, comfort, or convenience
    - e. Power supplier or local code requirements
2. Portable motors, 1/3 hp or less, may be connected and controlled by a plug and receptacle.
3. Stationary motors, 2 hp or less, may be controlled by a snap switch if motor amperes do not exceed 80% of ampere rating of switch.
4. Controls needed may include simple two-way switches, three-way and four-way switches, thermostats, humidistats, time clocks, solenoid valves, relays, photoelectric cells, and transformers.
5. Schematic diagrams for installing common equipment and controls follow.

CONDUCTOR INSULATORS

TW - Thermoplastic-Water Resistant
RU - Latex Rubber
RUW - Latex Rubber-Water Resistant
RUH - Latex Rubber-Heat Resistant
UF - Underground Feeder
WP - Weatherproof
USE - Underground Service Entrance
SEU - Service Entrance Unarmored

TABLE I

Allowable Current-Carrying Capacities of Insulated Copper and Aluminum Conductors in Amperes

	A Not more Than Three Conductors in Raceway or Cable, or Direct Burial				B Single Conductors in Free Air			
Size AWG or MCM	1 Rubber Insulation, Type R, RW, RU, RUW Type RH-RW in Wet Locations Thermoplastic Insulation, Type T, TW		2 Rubber Insulation, Type RH, RHW Type RH-RW in Dry Locations		3 Weatherproof Insulation, Type WP		4 Thermoplastic Insulation, Type TW	
	Copper	Aluminum	Copper	Aluminum	Copper	Aluminum	Copper	Aluminum
14	15		15		xx	xx	xx	xx
12	20	15	20	15	xx	xx	xx	xx
10	30	25	30	25	55	45	40	30
8	40	30	45	40	70	55	55	45
6	55	40	65	50	100	80	80	60
4	70	55	85	65	130	100	105	80
3	80	65	100	75	150	115	120	95
2	95	75*	115	90*	175	135	140	110
1	110	85*	130	100*	205	160	165	130
0	125	100*	150	120*	235	185	195	150
00	145	115*	175	135*	275	215	225	175
000	165	130*	200	155*	320	250	260	200
0000	195	155*	230	180*	370	290	300	230
250	215	170	255	205	410	320	340	265
300	240	190	285	230	460	360	375	290
350	260	210	310	250	510	400	420	330
400	280	225	335	270	555	435	455	355
500	320	260	380	310	630	490	515	405
600	355	285	420	340	710	560	575	455
700	385	310	460	375	780	615	630	500
750	400	320	425	385	810	640	655	515

If bare conductors are used with insulated conductors, their allowable current-carrying capacity shall be limited to that permitted for insulated conductors of the same size.

* For three-wire, single-phase service and sub-service circuits, the allowable current-carrying capacity of RH, RH-RW, RHH, and RHW aluminum conductors shall be for sizes No. 2-100 amp, No. 1-110 amp, No. 1/0-125 amp, No. 2/0-150 amp, No. 3/0-17- amp, and No. 4/0-200 amp.

xx No. 10 is minimum permissible in overhead spans up to 50 feet in length. For spans over 50 feet in length, No. 8 is minimum permissible. See 1956 NE Code, Section 7314b.

TABLE II

Wire Sizes Required for Loads up to 200 Amperes at 115-120 Volts, Based on 2% Voltage Drop

Load in Amps.	30	40	50	60	70	80	90	100	150	200	250	300	350	400
	Length of Run in Feet													
5	14	14	14	14	14	14	12	12	10	10	8	8	6	6
6	14	14	14	14	14	12	12	12	10	8	8	6	6	6
7	14	14	14	14	12	12	12	12	10	8	8	6	6	6
8	14	14	14	12	12	12	12	10	8	8	6	6	6	6
9	14	14	12	12	12	12	10	10	8	8	6	4	4	4
10	14	14	12	12	12	10	10	10	8	6	6	4	4	4
12	14	12	12	10	10	10	10	8	6	6	4	4	4	2
14	14	12	12	10	10	10	8	8	6	6	4	4	2	2
16	12	12	10	10	10	8	8	8	6	4	4	2	2	2
18	12	12	10	10	8	8	8	6	6	4	4	2	2	2
20	12	10	10	8	8	8	8	6	4	4	2	2	2	1
25	10	10	8	8	8	6	6	6	4	2	2	1	1	0
30	10	8	8	6	6	6	6	4	2	2	1	0	0	00
35	10^{b}	8	8	6	6	6	4	4	2	2	1	0	00	00
40	8	8	6	6	6	4	4	4	2	1	0	00	00	000
45	8^{a}	8^{a}	6	6	4	4	4	4	2	1	0	00	000	000
50	8^{b}	6	6	4	4	4	4	2	1	0	00	000	000	0000
60	6^{a}	6^{a}	4	4	4	2	2	2	1	00	000	000	0000	250M*
70	6^{b}	6^{b}	4	4	2	2	2	2	0	00	000	0000	250M	300M
80	6^{b}	4^{a}	4^{a}	2	2	2	2	1	00	000	0000	250M	300M	300M
90	6^{c}	4^{b}	4^{b}	2	2	2	1	1	00	000	0000	250M	300M	350M
100	4^{b}	4^{b}	2^{a}	2^{a}	2^{a}	1	1	0	000	0000	250M	300M	350M	400M
115	4^{c}	2^{a}	2^{a}	2^{a}	1	0	0	0	000	0000	300M	350M	400M	500M
130	4^{c}	2^{b}	2^{b}	1^{a}	1^{a}	0	00	00	0000	250M	300M	350M	500M	500M
145	4^{c}	2^{c}	1^{b}	1^{b}	0^{a}	00	00	00	0000	300M	350M	400M	500M	
160	4^{c}	2^{c}	1^{b}	0^{b}	0^{b}	00	00	000	250M	300M	400M	500M	500M	
180	2^{c}	2^{c}	1^{c}	0^{b}	00^{b}	00^{b}	000^{a}	000^{a}	250M	350M	500M	500M		
200	2^{c}	1^{c}	0^{c}	00^{b}	00^{b}	000^{a}	000^{a}	000^{a}	300M	400M	500M			

Wiring Materials and Controls
(Information Sheet continued)

SYMBOLS USED IN TABLE II

a. Type RH or RHW in cable or raceway; all types in air. For other types of wire in cable or raceway refer to Table I for minimum size permissible.

b. Weatherproof or Type TW in air. For wires in cable or raceway refer to Table I for minimum size permissible.

c. Weatherproof wire in air. For all other conditions refer to Table I for minimum size permissible.

*M - thousand circular mils.

NOTES: Conductors in overhead spans must be at least No. 10 for spans up to 50 feet and No. 8 for longer spans. See 1953 NE Code, Section 7314b. Feeder conductors must be at least No. 10. See 1953 NE Code, Section 2201.

TABLE III

Wire Sizes Required for Loads up to 400 Amperes at 230-240 Volts, Based on 2% Voltage Drop

Load in Amps.	Length of Run in Feet												
	40	50	60	70	80	90	100	150	200	250	300	350	400
5	14	14	14	14	14	14	14	14	12	12	10	10	10
6	14	14	14	14	14	14	14	12	12	10	10	10	8
7	14	14	14	14	14	14	14	12	12	10	10	8	8
8	14	14	14	14	14	14	14	12	10	10	8	8	8
9	14	14	14	14	14	14	12	12	10	10	8	8	8
10	14	14	14	14	14	12	12	10	10	8	8	8	8
12	14	14	14	14	12	12	12	10	8	8	6	6	6
14	14	14	14	12	12	12	12	10	8	8	6	6	6
16	12	12	12	12	12	12	10	8	8	6	6	6	6
18	12	12	12	12	12	10	10	8	6	6	6	4	4
20	12	12	12	12	10	10	10	8	6	6	4	4	4
25	10	10	10	10	10	10	8	6	6	4	4	4	2
30	10	10	10	10	8	8	8	6	4	4	4	2	2
35	10[b]	10[b]	10[b]	8	8	8	8	6	4	4	2	2	2
40	10[b]	10[b]	8	8	8	8	6	4	4	2	2	2	1
45	10[c]	10[c]	8[a]	8[a]	8[a]	6	6	4	4	2	2	1	1
50	10[c]	8[b]	8[b]	8[b]	6	6	6	4	2	2	1	1	0
60	8[b]	8[c]	6[a]	6[a]	6[a]	6[a]	4	2	2	1	1	0	00
70	8[b]	8[c]	6[b]	6[b]	6[b]	4	4	2	2	1	0	00	00
80	6[b]	6[b]	6[b]	6[b]	4[a]	4[a]	4[a]	2	1	0	00	00	000
90	6[c]	6[c]	6[c]	4[b]	4[b]	4[b]	4[b]	2	1	0	00	000	000
100	6[c]	6[c]	4[b]	4[b]	4[b]	4[b]	2[a]	1	0	00	000	000	0000
115	4[c]	4[c]	4[c]	4[c]	2[a]	2[a]	2[a]	1[a]	00	00	000	0000	250M*
130	4[c]	4[c]	4[c]	2[b]	2[b]	2[b]	2[b]	0[a]	00	000	0000	0000	250M
145	2[c]	2[c]	2[c]	2[c]	2[c]	2[c]	1[b]	0[a]	00	0000	0000	250M	300M
160	2[c]	2[c]	2[c]	2[c]	2[c]	1[b]	1[b]	00[a]	000	0000	250M	300M	300M
180	1[c]	1[c]	1[c]	1[c]	1[c]	1[c]	1[c]	00[b]	000[a]	0000	300M	300M	350M
200	1[c]	1[c]	1[c]	1[c]	1[c]	1[c]	0[c]	000[a]	0000[a]	250M	300M	350M	400M

Wiring Materials and Controls
(Information Sheet continued)

SYMBOLS USED IN TABLE III

a. Type RH or RHW in cable or raceway; all types in air. For other types of wire in cable or raceway refer to Table I for minimum size permissible.

b. Weatherproof or Type TW in air. For wires in cable or raceway, refer to Table I for minimum size permissible.

c. Weatherproof wire in air. For all other conditions refer to Table I for minimum size permissible.

*M - thousand circular mils

NOTES: Conductors in overhead spans must be at least No. 10 for spans up to 50 feet and No. 8 for longer spans. See 1953 NE Code, Section 7314b. Feeder conductors must be at least No. 10. See 1953 NE Code, Section 2201.

TABLE IV

Wire Sizes for Individual Single-Phase Motors, Based on 3% Voltage Drop on Full Load Current

			Length of Run in Feet														
Motor Horse Power	Volts	Approx. full load Amps.	50	75	100	150	200	250	300	350	400	500	600	700	800	900	1000
1/20	115	2.4	14	14	14	14	12	12	10	10	10	8	8	8	6	6	6
1/12	115	2.6	14	14	14	14	12	12	10	10	10	8	8	8	6	6	6
1/8	115	2.8	14	14	14	14	12	12	10	10	10	8	8	8	6	6	6
1/6	115	3.2	14	14	14	14	12	10	10	10	10	8	8	6	6	6	6
1/4	115	4.6	14	14	14	12	12	10	10	10	8	8	6	6	6	6	4
1/3	115	5.1	14	14	14	12	12	10	10	8	8	8	6	6	6	4	4
1/2	115	7.4	14	14	12	10	10	8	8	8	6	6	4	4	4	4	2
3/4	115	10.2	14	12	12	10	8	8	6	6	6	4	4	2	2	2	2
1/6	230	1.6	14	14	14	14	14	14	14	14	12	12	12	12	10	10	10
1/4	230	2.3	14	14	14	14	14	14	14	14	12	12	12	12	10	10	10
1/3	230	2.6	14	14	14	14	14	14	14	12	12	12	12	10	10	10	10
1/2	230	3.7	14	14	14	14	14	14	14	12	12	12	10	10	8	8	8
3/4	230	5.1	14	14	14	14	14	14	12	12	12	10	10	8	8	8	8
1	230	6.5	14	14	14	14	14	12	12	10	10	10	8	8	8	6	6
1 1/2	230	9.2	14	14	14	12	12	10	10	10	8	8	6	6	6	6	4
2	230	12	14	14	14	12	10	10	10	8	8	6	6	6	4	4	4
3	230	17	10	10	10	10	10	8	8	6	6	6	4	4	4	2	2
5	230	28	10[a]	10[a]	10[a]	8	6	6	6	4	4	2	2	2	1	1	0
7 1/2	230	40	8[b]	8[b]	8[b]	6	6	4	4	2	2	2	1	0	0	00	00
0	230	50	6[a]	6[a]	6[a]	6[b]	4	4	2	2	2	1	0	00	00	000	000

a. Type RH or RHW in cable or raceway; all types in air. For other types of wire in cable or raceway use next size larger.

b. For wires in cable or raceway use next size larger.

*M - thousand circular mils.

NOTE: Conductors in overhead spans must be at least No. 10 spans up to 50 feet and No. 8 for larger spans.
See 1953 NE Code, Section 7314b.

Wiring Materials and Controls
(Information Sheet continued)

The following problems will illustrate how these Tables may be used:

Problem 1:

We have a 1/2 horsepower electric motor on a water pump located 300 feet from our load center panel.

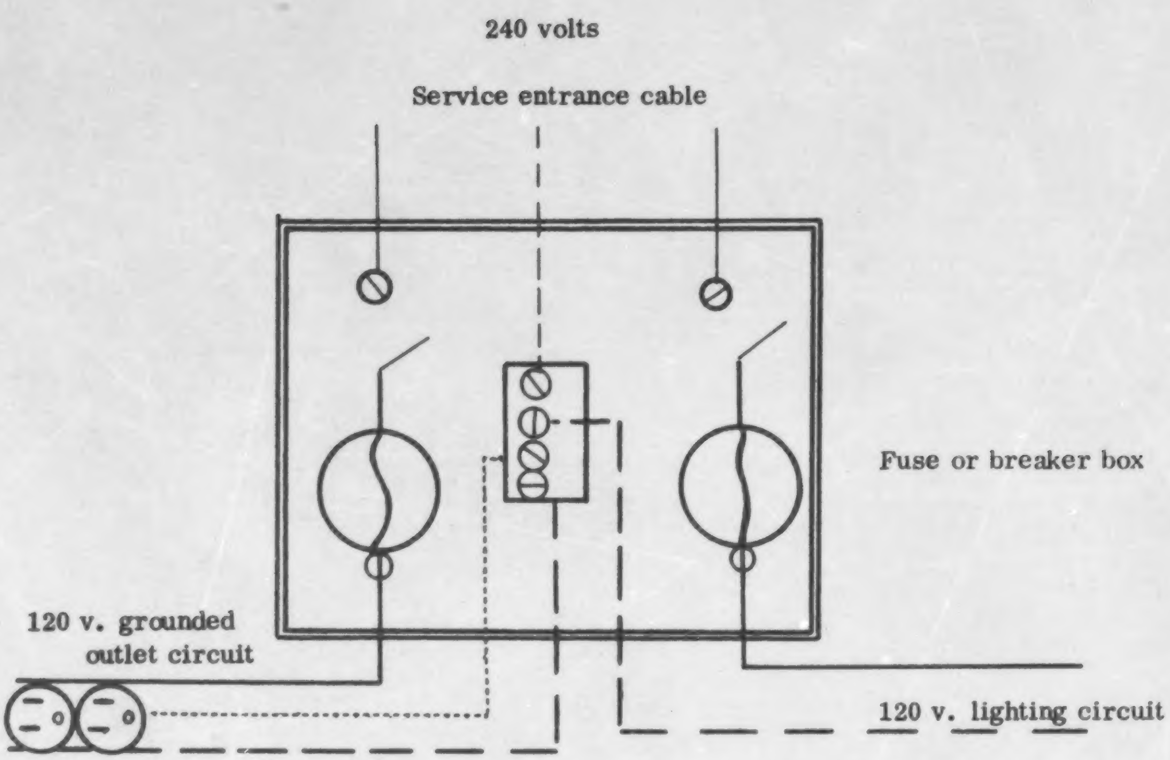
a. What size wire should we use if the motor is wired to operate on 115 volts? Answer: No. 8 wire - From Table IV

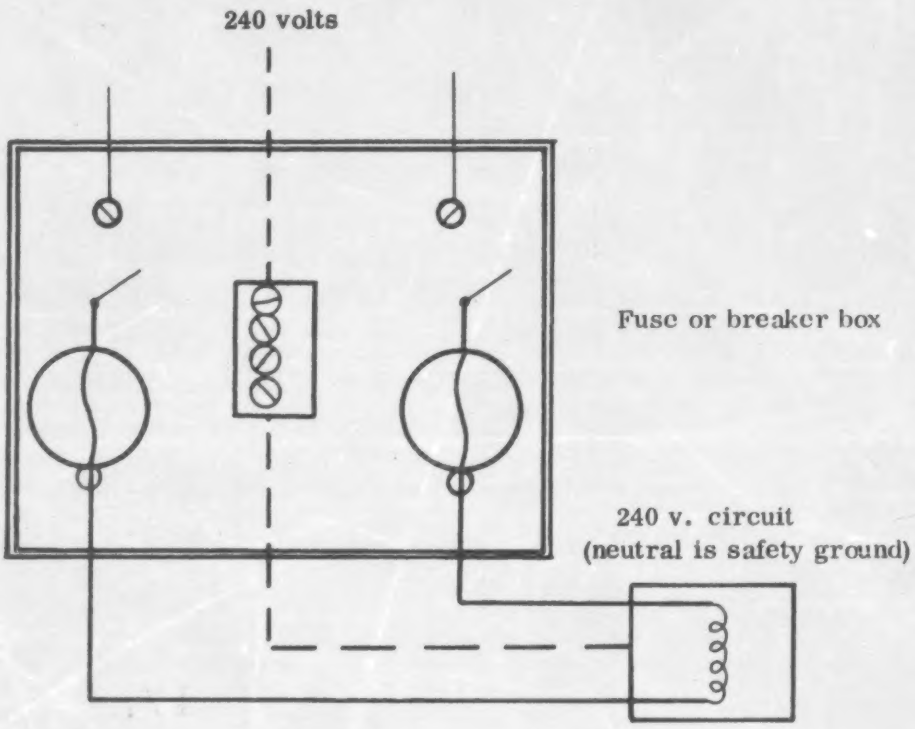
b. What size wire would be required if the motor was wired to operate 230 volts? Answer: No. 14 wire - From Table IV

c. What size wire would we need if the distance to the well was 50 feet and the motor was wired to operate on 115 volts? Answer: No. 14 wire - From Table IV

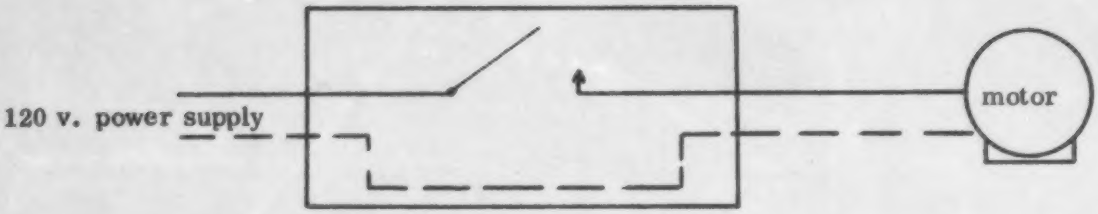
Problem 2:

We plan to install a 3000 watt dairy water heater in the milk room on our dairy farm. It is designed to operate on 230 volts. The distance from our load center panel to our water heater will be 80 feet. What size wire would we use? Answer: No. 12 wire - From Table III

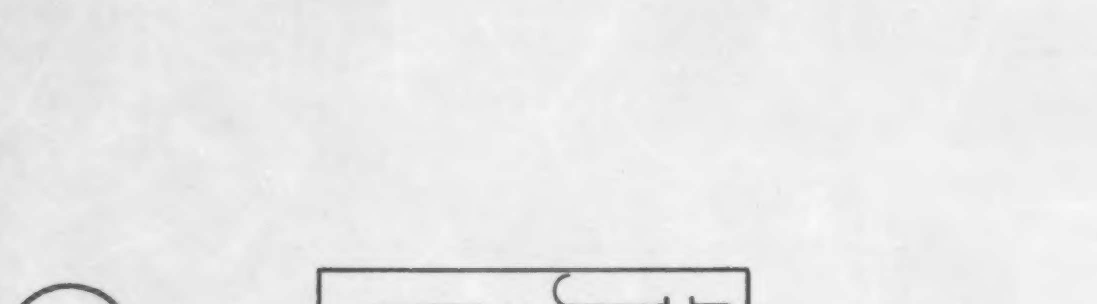

240 volts
Service entrance cable
Fuse or breaker box
120 v. grounded outlet circuit
120 v. lighting circuit


240 volts
Fuse or breaker box
240 v. circuit (neutral is safety ground)

SPST Switch

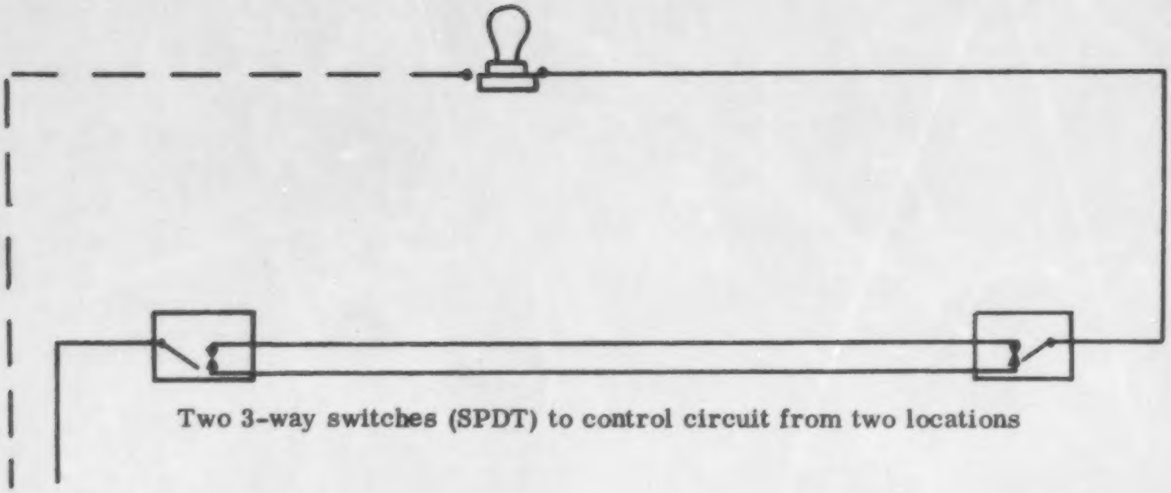

120 v. power supply
motor

Single Pole Single Throw Switch to Control Curcuit

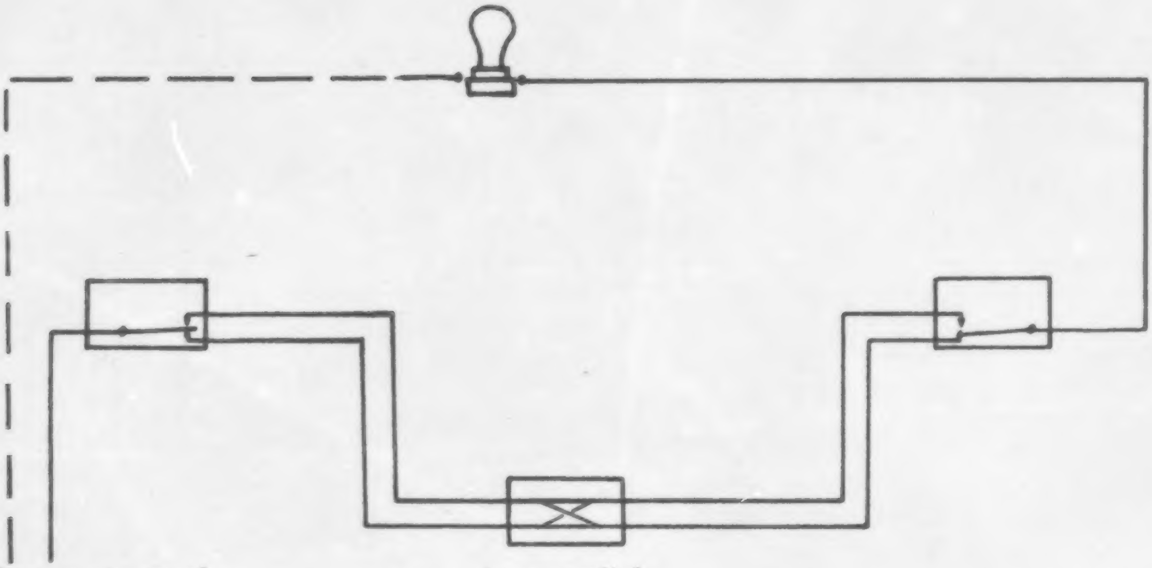

heater
motor
120 v. power supply

Switch

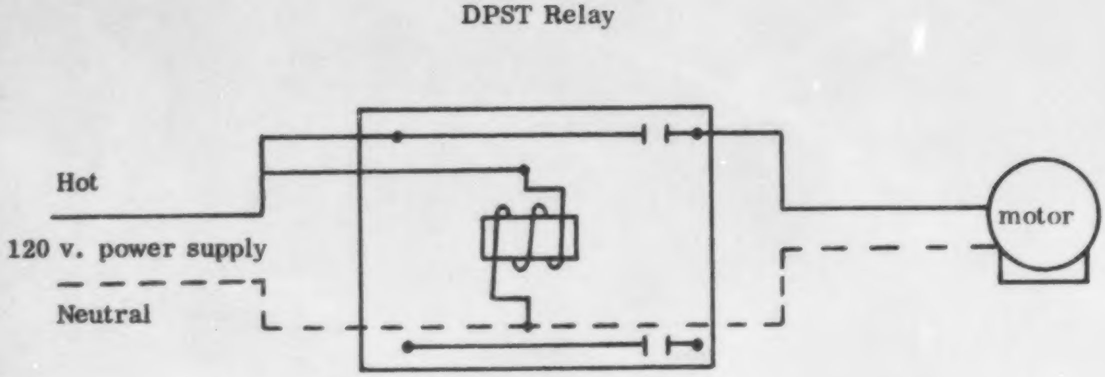
Switch with over-load Protection device to control Circuit


120 v. power supply
neutral
hot

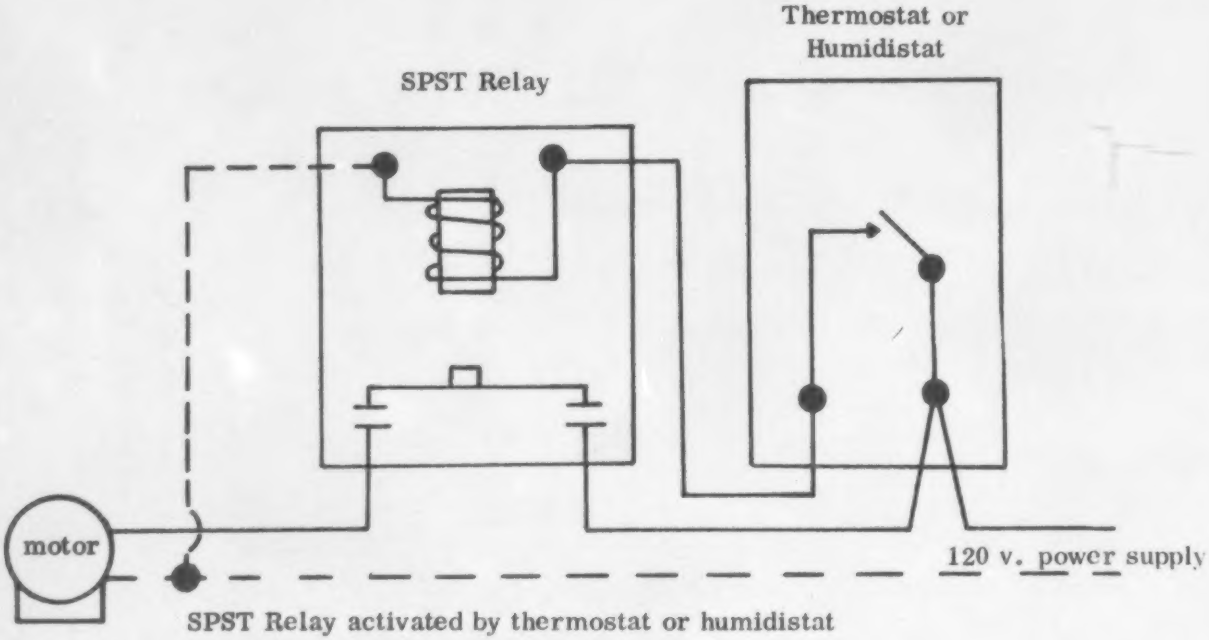
Two 3-way switches (SPDT) to control circuit from two locations


120 v. power supply
neutral
hot
4-way switch

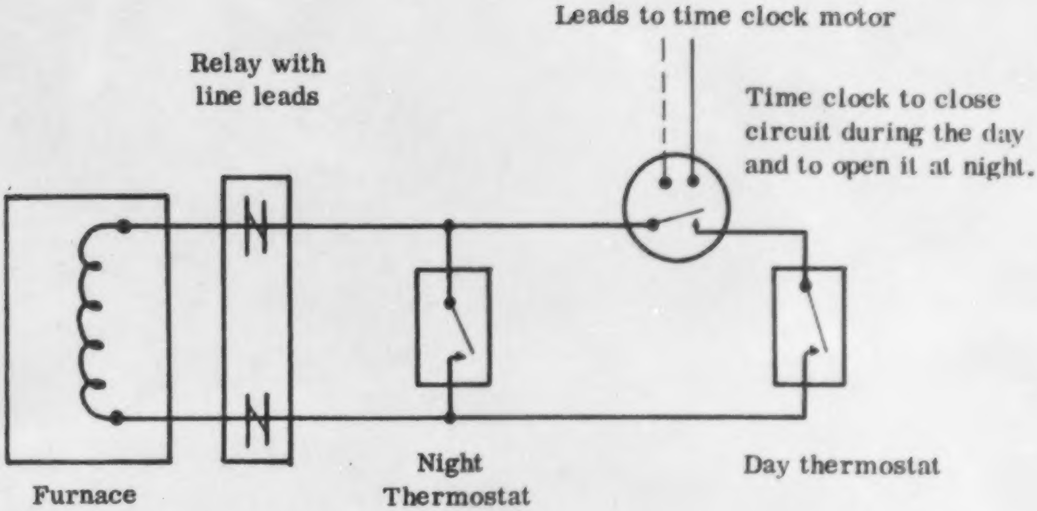
Two 3-way and one 4-way switch to control circuit from 3 locations.
(for each additional control point, a 4-way switch is needed.)


DPST Relay
Hot
120 v. power supply
Neutral
motor

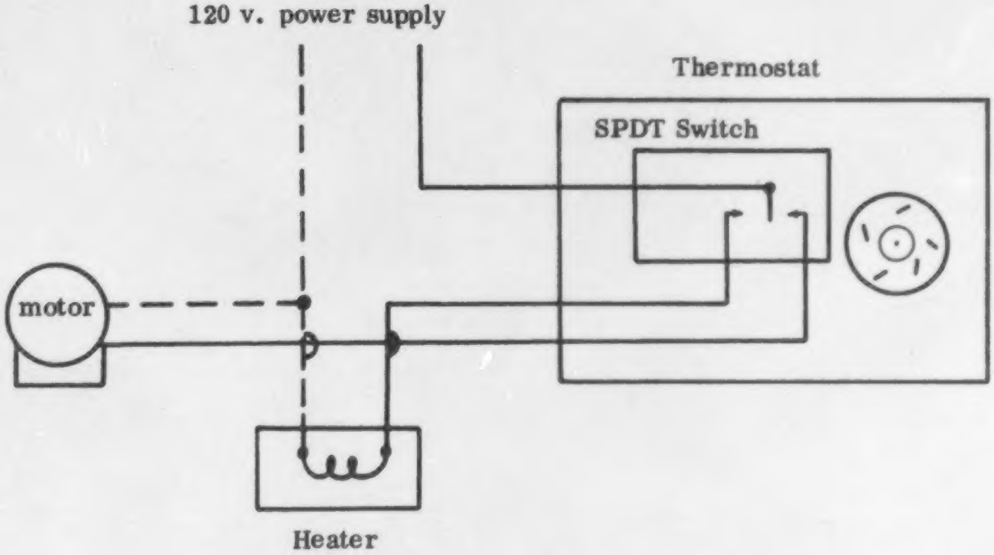
DPST Relay to open or close circuit


Thermostat or
Humidistat
SPST Relay
motor
120 v. power supply

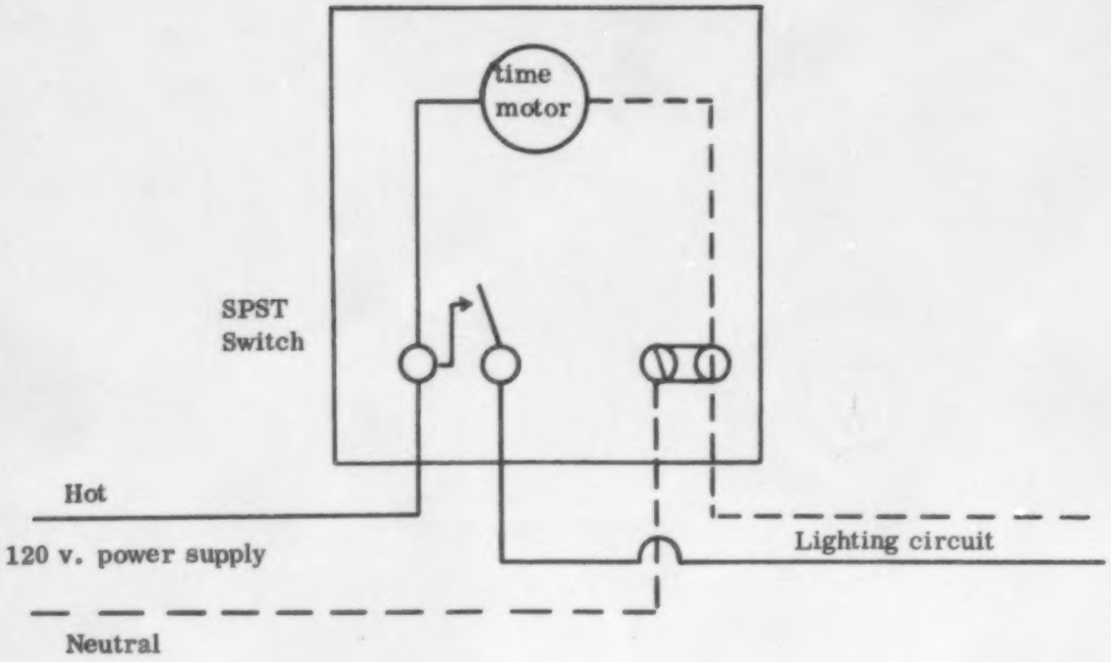
SPST Relay activated by thermostat or humidistat


Leads to time clock motor
Relay with line leads
Time clock to close circuit during the day and to open it at night.
Furnace
Night Thermostat
Day thermostat

Two thermostats and 24-hour time clock to automatically switch between different day and night temperatures.


120 v. power supply
Thermostat
SPDT Switch
motor
Heater

SPDT Thermostat to control both cooling and heating circuits.


time motor
SPST Switch
Hot
120 v. power supply
Neutral
Lighting circuit

Time Clock or repeat cycle timer to control lighting or other load

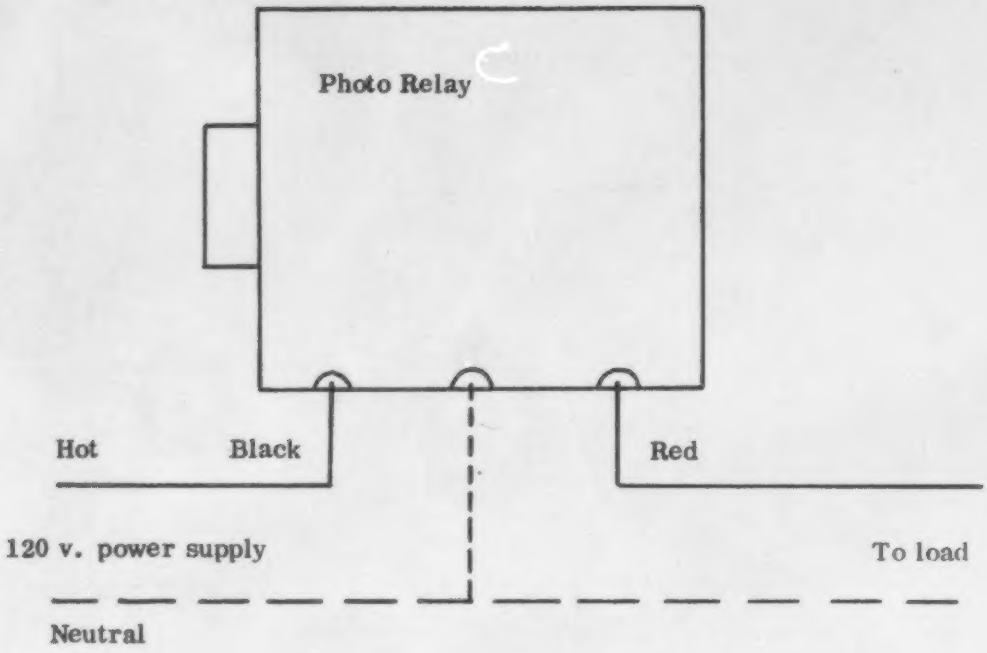
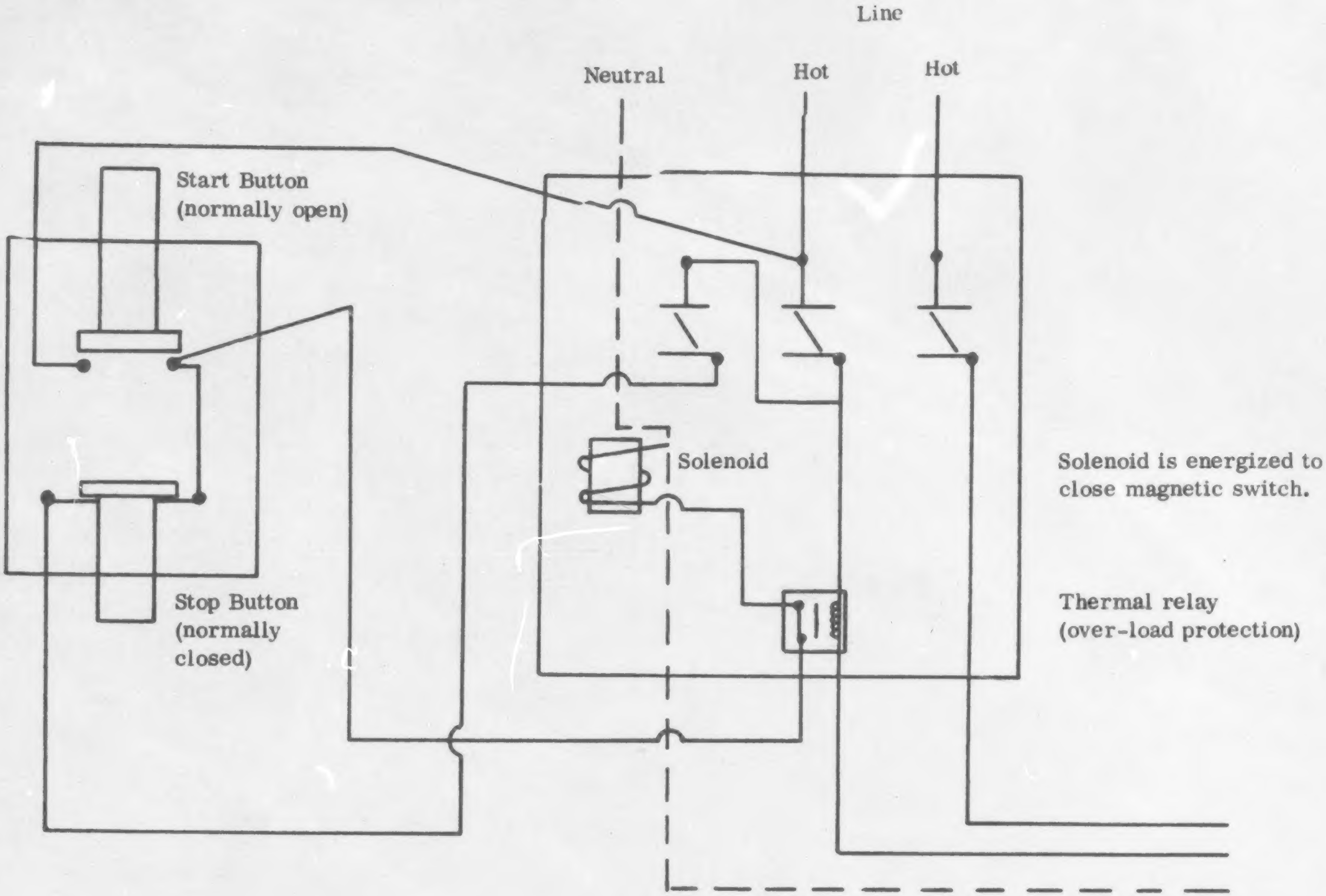


Photo Relay
Hot
Black
Red
120 v. power supply
To load
Neutral

Photo Relay to Control Lighting or other load


Line
Neutral
Hot
Hot
Start Button
(normally open)
Stop Button
(normally
closed)
Solenoid

Solenoid is energized to close magnetic switch.

Thermal relay (over-load protection)

MAGNETIC STARTER ACTIVATED WITH PUSH-BUTTON CONTROL STATION

Assignment Sheet
for
MILK PROCESSING PLANT EMPLOYEE

UNIT: Electrical Power and Refrigeration

TOPIC: Electric Motors

OBJECTIVE: To learn the various kinds of motors and their place of application.

REFERENCES:
Required:
Manual for Milk Plant Operators, Milk Industry Foundation, pp. 142-144

QUESTIONS OR ACTIVITIES:

1. What should a motor specification include?
2. What housing is recommended for milk plants on small motors?
3. What housing is recommended for large (5 hp and up) motors in the milk plant?
4. Why is it important to have spare motors on hand?
5. What do speed reducers eliminate?

Assignment Sheet
for
MILK PROCESSING PLANT EMPLOYEE

UNIT: Electrical Power and Refrigeration

TOPIC: "Sweet Water" and Brine Refrigeration Systems

OBJECTIVE: To determine and evaluate the difference between "Sweet Water" and Brine refrigeration systems.

REFERENCES:
Required:
Manual for Milk Plant Operators, Milk Industry Foundation, pp. 172-175

QUESTIONS OR ACTIVITIES:

1. What is the reason for using refrigeration in the milk plant?
2. When is water cooling practical?
3. What is a "Sweet Water" cooling system?
4. How is the "Sweet Water" system cooled below room temperature?
5. What is the advantage of the Brine cooling system over the "Sweet Water" cooling system?
6. Which Brine solution is best for the milk plant?
7. How is the Brine water cooled?

Assignment Sheet
for
MILK PROCESSING PLANT EMPLOYEE

UNIT: Electrical Power and Refrigeration

TOPIC: Mechanical Refrigeration Systems

OBJECTIVES: To learn the operative principles of mechanical refrigeration systems.

REFERENCES:

Required:

Manual for Milk Plant Operators, Milk Industry Foundation, pp. 175-183

QUESTIONS OR ACTIVITIES:

1. Of what does the simple mechanical refrigeration system consist?
2. Why should a shut-off valve be located on each piece of equipment?
3. What kind of protection shut-off switches should the compressor have?
4. What kind of evaporators can be used on the mechanical refrigeration system?
5. In a liquid recirculating system, where is the liquid stored for plant use?
6. What happens when the warm, high pressure liquid passes the control valve to the low pressure side?
7. Where are low temperature systems required in the milk plant?

Assignment Sheet
for
MILK PROCESSING PLANT EMPLOYEE

UNIT: Electrical Power and Refrigeration

TOPIC: Maintenance of Refrigeration Systems

OBJECTIVE: To learn the procedures of proper refrigeration system maintenance to provide efficient plant operation.

REFERENCES:

Required:

Manual for Milk Plant Operators, Milk Industry Foundation, pp. 186-193

QUESTIONS OR ACTIVITIES:

1. What is the first requirement for an efficient plant refrigeration operation?
2. What happens when modifications are made to the refrigeration system?
3. Why is it important to check and readjust operating controls on the refrigeration systems?
4. What is the only way to determine what is occurring within the system?
5. Why is good maintenance important to the milk plant equipment?
6. What is the main duty of maintenance personnel?

Assignment Sheet
for
MILK PROCESSING PLANT EMPLOYEE

UNIT: Plant Management

TOPIC: Product Losses and Records

OBJECTIVE: To learn how records can keep losses at a minimum.

REFERENCES:
Required:
Manual for Milk Plant Operators, Milk Industry Foundation, pp. 673-693

QUESTIONS OR ACTIVITIES:

1. What is the only way to keep product losses under control?
2. Why is butterfat accounting the most convenient means of evaluating efficiency?
3. What is the only reliable way of determining actual losses in the milk plant?
4. What are some things that cause milk losses?
5. What are the three ways of accounting generally accepted by the industry today?

Assignment Sheet
for
MILK PROCESSING PLANT EMPLOYEE

UNIT: Plant Management

TOPIC: Operating Efficiencies and Production Schedules

OBJECTIVE: To point out the need for efficiency in the milk plant operation.

REFERENCES:
Required:
Manual for Milk Plant Operators, Milk Industry Foundation, pp. 705-720

QUESTIONS OR ACTIVITIES:

1. What are some reasons for losses?
2. When used in conjunction with lowering of production costs, what does efficiency mean?
3. What is the concept of unit cost savings?
4. What increases labor efficiency?
5. What are some personnel factors that influence efficiency?
6. What are some plant and equipment areas that can be made more efficient for operating conditions?
7. What are the utilities involved in efficient production?
8. In the area of supplies, what causes a loss in operating efficiencies?

Assignment Sheet
for
MILK PROCESSING PLANT EMPLOYEE

UNIT: Plant Management

TOPIC: Container Losses

OBJECTIVE: To locate the causes of container losses for greater plant efficiency.

REFERENCES:
Required:
Manual for Milk Plant Operators, Milk Industry Foundation, pp. 693-704

QUESTIONS OR ACTIVITIES:

1. By what is the greatest glass milk bottle loss caused?
2. What are flaws in new milk bottles called?
3. How should new milk bottles be purchased to insure quality?
4. Under what conditions should bottles be stored?
5. What will bottle washing operations do to the bottle?
6. What three distinct types of breakage are bottles subjected to?
7. What is the most serious cause of breakage while in transit?
8. What should be done if the breakage is excessive?
9. How are paper container losses reflected?
10. What happens if paper containers are exposed to sunlight?

Assignment Sheet
for
MILK PROCESSING PLANT EMPLOYEE

UNIT: Plant Management

TOPIC: Waste Prevention

OBJECTIVE: To learn the procedures for keeping milk plant wastes to a minimum for greater plant efficiency.

REFERENCES:
Required:
Manual for Milk Plant Operators, Milk Industry Foundation, pp. 194-199

QUESTIONS OR ACTIVITIES:

1. What are the three important stakes the milk plant has in waste prevention?
2. What is the most important factor in preventing waste?
3. To what is a large portion of waste in the plant due?
4. What will result from moving of ground surfaces on sanitary fittings and valves?
5. What will result from power breakdowns or inaccurate temperature controls?
6. What should be done to leaky milk cans?
7. Why should foam be kept out of sewers?
8. Why should all bottles be inspected after washing?

Assignment Sheet
for
MILK PROCESSING PLANT EMPLOYEE

UNIT: Plant Management

TOPIC: Waste Disposal

OBJECTIVE: To learn the procedure of disposing of waste products.

REFERENCES:
Required:
Manual for Milk Plant Operators, Milk Industry Foundation, pp. 199

QUESTIONS OR ACTIVITIES:

1. What should be the cardinal rule for dumping spoiled milk or milk products?
2. What are the three excessive products found during the flush season?
3. What are three ways of handling excess milk products?
4. For what is a "weir notch" used?
5. Why is it important that waste sampling be done in proportion to flow?
6. Why is an automatic sampler best for collecting waste samples?
7. What are common tests made on waste liquids?
8. How should floor waste be pre-treated?
9. Why is a skimming baffle in front of the screen desirable?
10. How much land can be irrigated using waste liquids from a milk plant?

Assignment Sheet
for
MILK PROCESSING PLANT EMPLOYEE

UNIT: Plant Maintenance

TOPIC: Painting

OBJECTIVE: To learn the value of a properly painted milk plant.

REFERENCES:

Required:

Manual for Milk Plant Operators, Milk Industry Foundation, pp. 23-29

QUESTIONS OR ACTIVITIES:

1. What are two reasons for keeping the milk plant well painted?
2. Why does paint deteriorate rapidly in the milk plant?
3. What must painted areas be able to withstand in the milk plant?
4. What are the preparations that must be made before painting?
5. What are the two methods of applying paint?
6. What are some of the kinds of paint used in the milk plant?
7. What is code A-13?
8. Why should milk-proof paints be used?
9. Why are color conditions important in the milk plant?

Assignment Sheet
for
MILK PROCESSING PLANT EMPLOYEE

UNIT: Plant Maintenance

TOPIC: Floor, Roof, and Walls

OBJECTIVE: To learn the value of proper maintenance of the floor, roof, and walls in the milk plant.

REFERENCES:
Required:
Manual for Milk Plant Operators, Milk Industry Foundation, pp. 30-32

QUESTIONS OR ACTIVITIES:

1. What are the kinds of floor materials used in the milk plant?
2. Why should concrete not be used where chemical corrosion will occur?
3. What is recommended for the processing floors?
4. From what materials are industrial roofs made?
5. What is the best method of periodic maintenance for the roof?
6. With what kind of paint should rusting frames be painted?
7. What should be done for masonry wall cracks?
8. When should refinishing of walls be done?
9. What should be done to expansion joints every several years?

Assignment Sheet
for
MILK PROCESSING PLANT EMPLOYEE

UNIT: Plant Maintenance

TOPIC: Lighting, Ventilating, and Air Conditioning

OBJECTIVE: To learn the value and procedures for proper milk plant lighting, ventilating, and air conditioning.

REFERENCES:

Required:

Manual for Milk Plant Operators, Milk Industry Foundation, pp. 36-42

QUESTIONS OR ACTIVITIES:

1. With what economic gains will good lighting provide the milk plant?
2. How much light is needed in the milk plant?
3. What are the sources of light for the milk plant?
4. What areas should be considered for lighting?
5. What is the purpose of good ventilation?
6. How much fresh air does each person require per minute?
7. What must the ventilation system remove from the air?
8. Why is good ventilation important in the dairy plant?
9. How is heating done in the milk plant?
10. How much air conditioning is required per square foot of space?
11. What areas can be air conditioned in the milk plant?

Assignment Sheet
for
MILK PROCESSING PLANT EMPLOYEE

UNIT: Plant Maintenance

TOPIC: Lubrication

OBJECTIVE: To determine the value of proper lubrication of the milk plant equipment.

REFERENCES:
Required:
Manual for Milk Plant Operators, Milk Industry Foundation, pp. 824-840

QUESTIONS OR ACTIVITIES:

1. Why is lubrication of machinery necessary?
2. What does proper lubrication mean?
3. What is the meaning of viscosity?
4. What are the kinds of lubricants used in the milk plant?
5. What are the essential properties of fluid oils?
6. Why do greases afford better protection against rust?
7. Where are solid lubricants useful?
8. What are the types of bearings that need lubrication in the milk plant?
9. What happens when different kinds of greases are mixed when greasing ball bearings?
10. What equipment needs lubrication in the milk plant?

Answer Sheet
for
MILK PROCESSING PLANT EMPLOYEE

UNIT: Milk Processing Industry

TOPIC: Scope, Trends, and Opportunities

1. Milk

2. No other food

3. Availability, economic cost, and cultural attitudes

4. a. 1,488 lbs.
   b. 894 lbs.
   c. 835 lbs.
   d. 653 lbs.

5. a. 43.4
   b. 18.8
   c. 18.2
   d. 7.9

6. Buffalo, goat, sheep, reindeer, and water buffalo

7. 11.3 billion

8. Yes

9. To kill any pathogenic organisms that may be in the raw milk

10. Fourth

11. 18,679,000

Answer Sheet
for
MILK PROCESSING PLANT EMPLOYEE

UNIT: Milk Processing Industry

TOPIC: Job Training and Acceptance of Job Supervision

1. a. Explanation of job
   b. Duties of new employee
   c. Order of performance of job duties
   d. Explanation of job by new employee
   e. Demonstration of job to new employee
   f. Demonstration of job by new employee
   g. Motivation of new employee for efficiency
   h. Follow-up of job supervision

2. a. Create a desire to learn
   b. Make safety a habit
   c. Help employee develop job "know-how"
   d. Encouragement of accuracy in work
   e. Develop patience in work procedures
   f. Assistance in developing an attitude of ease for employee
   g. Set goals for employee
   h. Don't confuse employee with too many bosses
   i. Train employee at proper speed
   j. Build confidence in employee

3. Individual and group

Answer Sheet
for
MILK PROCESSING PLANT EMPLOYEE

UNIT: Milk Processing Industry

TOPIC: Plant Layouts

1. a. Function, expansion, and flexibility of plant and related facilities
   b. Determination of plant program requirements
   c. Site selection
   d. Building layout
   e. Building construction
   f. Economic justification
   g. Professional services

2. Do facilities meet the requirements of the company involvement ?

3. So expansion can occur without requiring construction changes, or interference with daily production

4. So that changes in processing, warehousing of supplies, and storage and distribution of finished goods can be made without excessive cost when technical progress or economic conditions require them

5. A "U" shaped design from receiving dock, through processing, and back to the dock for merchandising

6. Diagram of local milk plant

Answer Sheet
for
MILK PROCESSING PLANT EMPLOYEE

UNIT: Milk Processing Industry

TOPIC: Accident Prevention and First Aid

1. a. Moral responsibility on part of management
   b. Maintains good relationships
   c. Promotes goodwill with the buying public
   d. Reduces cost of insurance rates
   e. Less cost to plant in:
      1. Labor turnover
      2. Damage to equipment
      3. First aid and medical expenses
      4. Delays in deliveries
      5. Reduced overhead expenses
   f. Prevention costs are less than accident costs
   g. Safety increases efficiency

2. It means the controlling of men, machines, and materials.

3. To provide a means of tracking down the causes of accidents

4. a. Provide a good plant layout
   b. Establish safe working conditions
   c. Provide first aid facilities
   d. Provide personal protective equipment
   e. Study accident records
   f. Make a plant inspection for hazardous conditions
   g. Investigate accidents

Answer Sheet
for
MILK PROCESSING PLANT EMPLOYEE

UNIT: . Nutritional Properties of Milk

TOPIC: Secretion, Composition, and Properties of Milk

1. a. To be able to discuss milk with producers and consumers
   b. To understand and meet standards
   c. To understand the effect of changes in composition on processing and products
   d. To understand effect of components on defects

2. The whole, clean, fresh, lacteal secretion obtained by the complete milking of healthy cows, properly fed and housed, excluding that obtained within fifteen days before and five days after calving. (Plus local standards for fat and total solids and bacterial standards)

3. Most milk is secreted in the alveoli continuously between milkings.

4. Frequent milking decreases the pressure within the alveoli and udder, resulting in more secretion.

5. a. Water - 87.44%
   b. Protein - 3.3%
   c. Fat - 3.85%
   d. Lactose - 4.7%
   e. Ash - .72%

6. a. Breed
   b. Time of milking
   c. Seasonal variation
   d. Age of cow
   e. Disease
   f. Feed

7. a. Amount of fat
   b. Amount of solids-not-fat
   c. Size of fat globules
   d. Breed
   e. Feed

8. Higher content of carotene and fat, and larger fat globules

9. About 323 calories

10. About 23 pounds

Answer Sheet
for
MILK PROCESSING PLANT EMPLOYEE

UNIT: Nutritional Properties of Milk

TOPIC: Milk Fat

1. a. Fats - solid at room temperature
   b. Oils - liquid at room temperature

2. Very small particles that make up the milk fat

3. Causes the membrane film around the globule to break, enabling the globules to combine

4. Release of fatty acids during the decomposition of milk fat

5. Phosphatides, sterols, tocopherol (Vitamin E), carotenoids, and Vitamins A and D

6. Milk fat is more easily digested and larger amounts of it can be absorbed without producing a digestive disturbance.

7. Meat fat, egg fat, milk fat

8. Vegetable oils (cottonseed, soybean, or corn oil)

Answer Sheet
for
MILK PROCESSING PLANT EMPLOYEE

UNIT: Nutritional Properties of Milk

TOPIC: Milk Proteins

1. The Greek word "proteios," meaning "holding first place "
2. Amino acids
3. Eight
4. The number and amount of essential amino acids present
5. Casein
6. a. By addition of acid to change pH
   b. By addition of enzyme such as rennin
   c. By souring of milk by bacterial action
7. Skim milk of as low a fat content as is practical
8. 2.5 to 2.9 pounds
9. a. Health foods
   b. Media for bacteria
   c. Foodstuff additives
   d. Glues
   e. Paper coating
   f. Plastics
   g. Textiles
   h. Insecticide sprays
   i. Medicine
   j. Dairy feed additive
10. Whey
11. Lactalbumin (milk albumin) and lactoglobulin
12. By heat (above 160 degrees F.)

Answer Sheet
for
MILK PROCESSING PLANT EMPLOYEE

UNIT: Nutritional Properties of Milk

TOPIC: Milk Sugar

1. Lactose (milk sugar)

2. Glucose and galactose

3. 4.92%

4. Whey from hydrochloric (muriatic) acid casein

5. Alpha-lactose and beta-lactose

6. a. Solubility in water is low (17.8% at 77° F.)
   b. About one sixth as sweet as cane sugar

7. a. Infant foods
   b. Medicines
   c. Bakery products
   d. Candies
   e. Coffee cream substitutes
   f. Medium for mold growth
   g. Military smoke screens
   h. Mirrors
   i. Lactic acid

8. Lactose does not have the fattening effect of most other sugars.

Answer Sheet
for
MILK PROCESSING PLANT EMPLOYEE

UNIT: Nutritional Properties of Milk

TOPIC: Minerals and Water in Milk

1. Ash content

2. a. Calcium influences action of rennin and the production of evaporated milk.
   b. Copper and iron may be associated with undesirable flavors.

3. Aluminum and stainless steel

4. It is remarkably constant. Removing the mineral from the feed or adding it to the feed of a cow does not alter the calcium content of the milk.

5. Ten to twenty percent of the calcium becomes less available.

6. a. Acid medium in intestinal tract
   b. Pressure of milk fat
   c. Presence of Vitamin D

7. Because they cause milk to develop undesirable flavors

8. Water (87%)

Answer Sheet
for
MILK PROCESSING PLANT EMPLOYEE

UNIT: Nutritional Properties of Milk

TOPIC: Vitamins in Milk

1. Content of carotene and related yellow pigments

2. Milk fat

3. The content of carotene in the ration of the animal and the fat content of the milk.

4. B complex vitamins

5. Thiamine, riboflavin, niacin, pantothenic acid, folic acid, biotin, pyridoxine, vitamin B_{12}

6. Thiamine content is constant until processing. Pasteurization destroys about 10 to 20% except when the short time-high temperature process is used, then only about 3% is lost.

7. a. Feed the cow consumes
   b. Exposure to light

8. Most of the Vitamin C is lost in processing and storage.

9. a. By adding materials rich in Vitamin D to feed
   b. Irradiating of milk with ultra-violet light
   c. Adding Vitamin D concentrates directly to the milk

10. Folic acid, vitamin C, and vitamin E

Answer Sheet
for
MILK PROCESSING PLANT EMPLOYEE

UNIT: Microbiology and Sanitation

TOPIC: Microbiology of Dairy Products

1. By its bacterial content

2. Bacilli and cocci

3. a. First part of name gives the genus
   b. Second part of name gives the species

4. By controlling the temperature

5. Certain bacteria may be useful in producing one product and yet be undesirable in another product.

6. All disease-producing organisms. but some harmless bacteria survive.

7. By sterilizing milk cans and equipment and by washing the cow's udder with a disinfectant before milking

8. Yeasts - To ripen certain types of cheese and fermented milk
   Molds - Certain molds are essential in producing some special types of cheeses

9. They may influence undesirable changes in flavor.

10. It inactivates most enzymes.

11. Lipase which causes development of rancidity

Answer Sheet
for
MILK PROCESSING PLANT EMPLOYEE

UNIT: Microbiology and Sanitation

TOPIC: Milk and Diseases

1. In the cow's udder

2. a. Care of cows on the modern dairy farm
   b Use of milking machines, pipe lines, and refrigerated holding tanks

3 Modern sanitary measures, milk inspection, medical examination of milk handlers, pasteurization, and use of certified milk

4. Contamination by an infected milk handler

5 Through the use of raw milk

6 Tuberculosis, brucellosis, leptospirosis, and Q Fever

7. 145 degrees F for 30 minutes or 160 degrees F. for 15 seconds

8. Typhoid fever, paratyphoid fever

Answer Sheet
for
MILK PROCESSING PLANT EMPLOYEE

UNIT: Microbiology and Sanitation

TOPIC: Antibiotics, Pesticides, and Radioactivity

1. a. When infused into the udder of a cow
   b. Use of feed containing antibiotic supplements

2. a. People sensitive to the antibiotic may develop a severe allergic reaction.
   b. Pathogenic bacteria may develop a tolerance for the antibiotic.

3. a. Inhibit growth of bacteria; affect the grade of milk
   b. Inhibit growth of lactic acid organisms, affecting starter cultures

4. Infusion into udder - 72 hours
   Intramuscular injection - 96 hours

5. Zero

6. DDT, TDE, lindane, chlordane, heptachlor, dieldrin, aldrin, and endrin

7. Use of X-rays and radium in medicine and industry

8. The Division of Radiological Health of the United States Public Health Service

Answer Sheet
for
MILK PROCESSING PLANT EMPLOYEE

UNIT: Microbiology and Sanitation

TOPIC: Housekeeping Principles

1. Health of the enterprise, product quality, employee morale, costs, and efficiency of operation

2. Rising standard of living and concepts of cleanliness

3. Increase good will and sales if the public has good impression of the plant. Tours can harm business if housekeeping is not good.

4. A sound, well-designed plant building, painted, and in good repair

5. The producer is not encouraged to maintain a clean barn, healthy herd, and spotless milkhouse if his product is handled in a rundown, poorly kept processing plant

6. Management, supervisors, and employees

7. Leads to safer working conditions, prevents falls and other accidents

8. a. Pre-employment and periodic examinations by physician
   b. Absence from work if communicable disease is contracted
   c. Personal cleanliness - especially hands
   d. Clean uniform and cap every day

Answer Sheet
for
MILK PROCESSING PLANT EMPLOYEE

UNIT: Microbiology and Sanitation

TOPIC: Cleaning and Caring for Equipment

1. Milk sugar, butterfat, proteins, and mineral salts

2. Acid solution

3. a. Heating at minimum temperature for minimum time
   b. Cooling milk heating surfaces before and during emptying of vats
   c. Rinsing equipment immediately after use
   d. Keeping film on equipment moist until ready to clean
   e. Rinse with warm water
   f. Using sodium (not calcium) hypochlorite for sanitizing

4. Stiff-bristled brushes and rapidly recirculated solutions

5. a. Wetting and penetration
   b. Emulsification
   c. Saponification
   d. Deflocculation
   e. Solution
   f. Sequestering and chelating

6. a. Alkalies
   b. Acids
   c. Polyphosphates and chelating chemicals
   d. Wetting agents

7. With an alkaline rinse to neutralize acid

8. 115 to 120 degrees F., melting point of milk fat and temperature at which casein will coagulate and "cook" on equipment

9. a. Equipment receives uniform treatment
   b. Saves 25% or more of clean-up cost
   c. Improves plant appearance
   d. Reduces possibility of contamination through human error

10. a. Proper engineering and installation
    b. Temperature of cleaning solution
    c. Adequate velocity of the detergent solution
    d. Use of detergents designed for recirculation cleaning
    e. Sufficient cleaning time

UNIT: Microbiology and Sanitation
TOPIC: Cleaning and Caring For Equipment
(Answer Sheet continued)

11. Acid is circulated with an alkali cleaner added directly to acid solution until the alkali "over-rides" the acid, making the solution alkaline.

12. a. Rinse with hot water (115 to 120° F.)
    b. Scrub all surfaces with brush and cleaning solution after disassembly if needed
    c. Rinse with hot water
    d. Drain

Answer Sheet
for
MILK PROCESSING PLANT EMPLOYEE

UNIT: Microbiology and Sanitation

TOPIC: Sanitizing Dairy Equipment

1. Cleaning equipment and destroying as many micro-organisms as possible

2. a. Rinsing equipment with warm water
   b. Cleaning with alkaline or acid solution , and rinsing
   c. Sanitizing with heat or chemical

3. Sanitary Standards Committee

4. At least 170^{o} F. for at least 5 minutes

5. Surfaces must be free of organic material

6. 160^{o} F. for 16 seconds

7. a. Requires much steam to heat all surfaces to 160^{o} F.
   b. Temperature of steam may drop after it leaves the hose and become ineffective
   c. Requires heavy, costly hose
   d. Cost is high
   e. Safety hazard
   f. May cause distortion of equipment if improperly used

8. Chlorine, iodine, and quaternary ammonium compounds

9. Cause corrosion if left in contact with metals

10. a. Flushing
    b. Spraying and brushing
    c. Fogging
    d. Submersion

Answer Sheet
for
MILK PROCESSING PLANT EMPLOYEE

UNIT: Microbiology and Sanitation

TOPIC: Cans and Can Washing

1. Receiving milk from farms, inter-plant transfer, storage, and containers for products in wholesale trade

2. Aluminum, stainless steel, and tinned steel

3. Pit easily and are difficult to clean

4. Stainless steel

5. In inverted position with cover off, in a clean, dry place that is free from dust

6. Because of their special outlets

7. a. Pre-rinse with warm water
   b. Immerse can in warm alkaline solution and scrub inside and out
   c. Rinse in clear, hot water
   d. Steam or immerse in quaternary ammonium solution for two minutes
   e. Invert to store and dry
   f. To remove milkstone, use acid solution instead of alkaline solution every fourth day

8. Water, cleaner solution, hot water, steam, hot air

9. On hardness of the water

10. a. Drain and rinse tanks
    b. Remove and clean spray nozzles
    c. Rinse pipes and nozzles
    d. Remove and clean pump strainers
    e. Leave shields off to allow drying

11. a. Lack of regular, proper, and sufficient lubrication of the moving parts
    b. Failure to make adjustments for wear
    c. Failure to replace worn-out parts

12. a. Improper or inadequate daily cleaning
    b. Use of hard water
    c. Use of a wash solution which causes the formation of hard water deposits

Answer Sheet
for
MILK PROCESSING PLANT EMPLOYEE

UNIT: Microbiology and Sanitation

TOPIC: Bottle Washing

1. Hand washing, pressure washing, and soaker washing using the brush or hydro type machine

2. In case of breakdown of the bottle washer

3. Hand brush or motor-driven brush and a mild alkaline solution

4. In small plants

5. Strong acid solution

6. Careful inspection of the bottles and removal of all damaged or broken bottles

7. 2.3% alkali, 1.6% caustic

8. Proper time, temperature, and caustic concentration

9. To determine the sodium hydroxide concentration - measure the sterilizing power of the soaker solution

10. As an added safeguard to proper sterilization

11. Motor, pumps, drive chains, and gears

12. A special soap

Answer Sheet
for
MILK PROCESSING PLANT EMPLOYEE

UNIT: Microbiology and Sanitation

TOPIC: Insect and Rodent Control

1. The "preventive concept" is the attempt to keep the plant clean of odors which will attract insects and rodents.

2. The "mayhave" clause as interpreted by the Federal Food and Drug Administration, and upheld by the courts, means that if the inspector finds conditions existing whereby product contamination could take place, he can condemn the products being produced.

3. Under provisions of the Federal Law management is held responsible.

4. Houseflies, roaches, rats, mice

5. Destroy their breeding places such as manure piles, garbage dumps, and drainage areas.

6. Flies are kept out of the buildings by protecting openings with fine mesh screens, high speed air curtains, double-swinging, double doors, and a vestibule trap with a sprayer containing a suitable insecticide.

7. Entomology Department of State College of Agriculture

8. Eliminate all dark and moist places. Places such as cracks, crevices, hollow walls, and objects under which they can hide and breed should also be eliminated.

9. Yes

10. a. Elimination of harborage and breeding places around the outside of the plant.
    b. Rodent-proofing of all buildings
    c. Perimeter baiting in weatherproof lock-boxes
    d. Elimination of all harborage and hiding places inside the plant, forcing the rodents to live in the open
    e. A continuous trapping program inside the plant that is waiting constantly for the rodent that may get by the program intended to prevent entry

Answer Sheet
for
MILK PROCESSING PLANT EMPLOYEE

UNIT: Milk Quality and Control

TOPIC: Grades and Classes of Milk

1. Market milk and manufacturing milk

2. Because, in its separation, bacteria are carried mechanically from the milk into the cream.

3. To prevent fraud and adulteration, and cover factors that affect sanitation and public health

4. Federal, state, and local laws and ordinances

5. The copyrighted name given to raw and pasteurized milk produced under the rules and regulations published in the "Methods and Standards for the Production of Certified Milk "

6. a. Raw - 10,000 bacteria per milliliter
   10 coliform organisms per milliliter
   b. Pasteurized - 500 bacteria per milliliter
   1 coliform organism per milliliter

7. a. Dairy must conform to sanitation regulations of local and state authorities.
   b. Bacterial count not over 50,000 per milliliter
   c. Milk must be from cows free of tuberculosis and brucellosis
   d. Milk cooled to 50°F. or lower immediately after milking and held below 50°F. until delivery

8. Grade A, Grade B, Grade C

9. Fluid market milk, or Class I milk

10. Class II - Cottage cheese, ice cream, and cultured milk products
    Class III - Evaporated milk, dried milk products, hard cheeses, and butter

11. Minimum prices paid to the producers by processors

12. a. Provide a stable and orderly market for producers
    b. Regulate competition among processors
    c. Assure consumers of a dependable and adequate milk supply

Answer Sheet
for
MILK PROCESSING PLANT EMPLOYEE

UNIT: Milk Quality and Control

TOPIC: Flavor and Physical Defects

1. Substances that are in solution

2. Affects it very little if any

3. a. From feed
   b. From biochemical change
   c. From condition of cow
   d. From environment

4. By cows having no access to feeds for at least four hours before milking

5. a. Sour or acid
   b. Oxidized or cardboard
   c. Rancid

6. Cooked flavor

7. A cow in poor health or in a late stage of lactation

8. a. 158° to 161°F. for 30 minutes
   b. 168° to 172°F. for 20 seconds

9. Ropy milk and mastitis flakiness

10. a. Sour or clabbered milk
    b. Shallow cream layer
    c. Partially churned milk
    d. Foaming

Answer Sheet
for
MILK PROCESSING PLANT EMPLOYEE

UNIT: Milk Quality and Control

TOPIC: Sampling

1. A sample that is representative of the milk

2. Thorough mixing or agitation

3. Mixture of single samples from different lots of milk

4. Amount in proportion to the amount of milk sampled

5. The dipper method

6. To prevent bacterial growth during the sampling period

7. At least 150cc.

8. a. Warm samples to 70° - 73°F.
   b. Rotate container and smell of sample
   c. Taste small amount (15 ml.) and roll around mouth. Exhale through the nose; do not swallow the milk; spit out and notice any after-taste.
   d. Record the flavor
   e. Rinse mouth with warm water after a strong flavor is detected

Answer Sheet
for
MILK PROCESSING PLANT EMPLOYEE

UNIT: Milk Quality and Control

TOPIC: Bacteriological Tests

1. The Standard Plate Count

2. Substance that serves as medium for growth of bacteria

3. A mass of bacteria in a fixed position on the medium that is visible to the eye

4. 1:10, 1:100, and 1:1,000

5. Standard Plate Count of 33,000 per milliliter

6. a. Bacteria that do not grow well at the temperature or on the particular medium used
   b. Over-crowding of plates

7. a. Requires much equipment
   b. Results not obtained until after two days

8. a. Micro-plate
   b. Oval tube
   c. Roll tube

9. a. Acid and water-free stain
   b. Aniline oil methylene blue stain
   c. Newman-Lampert stain
   d. Standard methods (Levowitz-Weber) stain

10. Because the dead organisms are stained and counted

11. The degree of activity of certain types of bacteria

12. a. Gives results in 3 hours
    b. Permits detection of colostrum and of milk from diseased udders

Answer Sheet
for
MILK PROCESSING PLANT EMPLOYEE

UNIT: Milk Quality and Control

TOPIC: Butterfat Tests

1. Price is usually based on the fat content.

2. The Babcock fat test

3. a. Put 17.5 ml. of milk into milk test bottle with milk pipet
   b. Add 17.5 ml. of sulphuric acid slowly
   c. Mix with smooth rotary motion until all curd is dissolved
   d. Whirl test bottles in centrifuge for 5 minutes
   e. Add hot water to fill the bulb of the bottle
   f. Whirl in centrifuge for 2 minutes
   g. Add hot water to bring fat column near the top of the neck of the bottle
   h. Run in centrifuge for 1 minute
   i. Place bottle in water bath (130° - 140°F.) for 3 minutes
   j. Measure fat column with dividers

4. a. Acid too strong
   b. Too much acid
   c. Milk or acid too warm when mixed
   d. Allowing milk and acid to stand in bottle before mixing
   e. Improper shaking to mix milk and acid

5. a. Weak acid
   b. Too little acid
   c. Acid or milk too cold
   d. Insufficient mixing

6. A special test bottle with smaller graduated neck

7. Butyl alcohol test

8. Cannot be measured accurately by volume

9. a. Gerber or Fucoma Fat Test
   b. Combined Acid and Detergent Test
   c. Detergent Tests (BDI and TESA or Banco Test)
   d. Ether Extraction (Mojonnier Method)

10. Ether Extraction (Mojonnier Method)

Answer Sheet
for
MILK PROCESSING PLANT EMPLOYEE

UNIT Milk Quality and Control

TOPIC: Solids-Not-Fat Tests

1. From the fat content and specific gravity

2. By using a lactometer

3. a. Quevenne lactometer - milk at 60°F.
   b. Watson lactometer - milk at 102°F.

4. 1000 times the specific gravity minus 1000

5. 15 to 40 - read as 1.015 to 1.040

6. 26 to 37

7. a. Put well mixed milk in cylinder large enough to float the lactometer and with a diameter larger than the bulb of the lactometer
   b. Container should overflow when lactometer is placed in it
   c. Allow lactometer to float freely for one-half minute before taking reading
   d. Blow bubbles from surface and read at the highest point of the meniscus

8.

$$\text{SNF} = \frac{\%\ \text{Fat}}{5} + \frac{\text{Corrected lactometer reading}}{4}$$

$$\text{Total Solids} = 1.2 \times \text{Fat}\ \% + \frac{\text{Corrected lactometer reading}}{4}$$

9. 1.030 at 60°F.

10. Gravimetric test

Answer Sheet
for
MILK PROCESSING PLANT EMPLOYEE

UNIT: Milk Quality and Control

TOPIC: Acidity Tests

1. Age and bacterial activity

2. Percent lactic acid

3. By titration

4. 1.0% normal sodium hydroxide

5. 1% normal sodium of phenolphthalein in alcohol

6. $\% \text{ acidity} = \dfrac{\text{ml. } 0.1 \text{ N alkali} \times 0.009}{\text{weight of sample}} \times 100$

7. a. pH of 7 - Neutral reaction
   b. pH above 7 - Alkaline reaction
   c. pH below 7 - Acid reaction

8. a. Electrical apparatus
   b. Colorimetric determinations with indicator solutions

9. Resist a change of pH - Tend to maintain a constant pH

Answer Sheet
for
MILK PROCESSING PLANT EMPLOYEE

UNIT: Milk Quality and Control

TOPIC: Miscellaneous Tests

1. a. Foreign matter is objectionable
   b. Indicates carelessness in processing
   c. Indicates that non-visible foreign matter has gone into solution
2. To determine whether the product has been properly pasteurized or whether it contains a detectable amount of raw product
3. Content of fat, moisture, and salt
4. Measure the freezing point of the milk sample
5. 31°F.
6. An apparatus called Hortvet cryoscope
7. No significant effect
8. The relative insolubility of the protein in goat's milk as compared to that of cow's milk when dissolved is an alkaline solution.

Answer Sheet
for
MILK PROCESSING PLANT EMPLOYEE

UNIT. Milk Quality and Control

TOPIC: Standardizing- Dairy Arithmetic

1. Multiply pounds of each product by its percent of fat to obtain total pounds of fat. Divide total pounds of fat by total weight of products and multiply by 100.

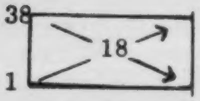
2. Adjusting the percentage of fat to a definite amount for uniformity

3. To make calculation for standardizing milk or cream

4. The proportion of each ingredient to use

5. Number of parts of one product is to the total number of parts of total product as X is to total pounds of product desired (multiply means and extremes)

6.



17 parts of cream
20 parts of skim milk
37 total parts

17: 37: : X : 900 (multiply means and extremes)
37X = 15300
X = 413.51 lbs. of cream

20: 37: : X : 900
37X = 18000
X = 486.48 lbs. of skim milk

	413.51 lbs.	of cream
	486.48 lbs.	of skim milk
Total	899.99 lbs.	of 18% cream

7. Solids-not-fat % = 7.07 plus 0.4 times fat %

8. 600 x 0.04 = 24.00 lbs. of fat

Answer Sheet
for
MILK PROCESSING PLANT EMPLOYEE

UNIT: Milk Quality and Control

TOPIC: Grades of Cream

1. a. Light, coffee, or table - 18 to 20% fat
   b. Light whipping - 30 to 36% fat
   c. Heavy whipping or pastry - minimum 46% fat

2. Cream that has naturally risen to the top

3. By a special type separator; 65 to 85% fat

4. 10% to 12% fat

5. The consumer considers a deep cream line indicative of rich milk.

6. Large fat globules which rise to the very top of the cream line

7. Sodium citrate

8. By its thickness

9. Freon C-130

10. 6 to 8 times

11. Sterilized cream is produced by adding 0.10% to 0.30% sodium alginate, a gelatinous gum from seaweed, to prevent coagulation during sterilization. It is then flash-pasteurized at 280° - 300°F. or by adding steam under high pressure at 260° to 280°F. for 4 minutes. The cream is then homogenized at 2000 pounds pressure and again at 500 pounds pressure.

12. Cream obtained from other than Grade A milk used for making butter, ice cream, and cheese

Answer Sheet
for
MILK PROCESSING PLANT EMPLOYEE

UNIT: Milk Processing Equipment

TOPIC: Equipment Layout

1. How the products are to be packaged

2. System of product distribution

3. Rates and volumes of the packaging system.

4. To provide the most economical use of available floor space with equipment arranged to obtain the maximum processing volume per man-hour.

5. a. Straight-through plan
    b. The "U" plan
    c. The "T" plan

6. So testing of samples can be done readily

7. Space limitations

8. As much CIP (cleaning in place) cleaning as possible

9. Congestion of trucks

10. a. The available site
    b. Regulations of various controlling agencies
    c. Operation limitations

Answer Sheet
for
MILK PROCESSING PLANT EMPLOYEE

UNIT: Milk Processing Equipment

TOPIC: Materials for Dairy Equipment

1. Strength, function, economy, durability, and sanitation

2. To prevent corrosion

3. 18-8 stainless steel

4. It is soft, its tin coating wears off quickly, and the exposed copper affects the flavor of milk products.

5. For cylinders of ice cream freezers

6. For tinning steel milk cans

7. It is porous and is affected by alkaline cleaners.

8. High tin or silver solders

9. Contains 18% chromium and 8% nickel

10. Particles of steel become imbedded and will rust and discolor the stainless steel.

11. a. Those requiring flexibility and elasticity
    b. Those requiring hardness, rigidity, impact resistance, and high and low temperature resistance

Answer Sheet
for
MILK PROCESSING PLANT EMPLOYEE

UNIT: Milk Processing Equipment

TOPIC: Sanitary Pipe and Fittings

1. The amount of product to be pumped through it in a given period of time

2. To achieve maximum service life and proper functioning of piping, valves, and fittings

3. Every 10 feet

4. Corrosion

5. They offer a closed system less susceptible to contamination and easier to clean.

6. The ability to visually inspect it for physical cleanliness

7. For bulk tanker unloading and on farm pick-up trucks

8. a. Threaded fittings
   b. Clamp type fittings
   c. Butt weld fittings

9. Gasket seat fitting

10. Direct or reverse-acting types in single or double position

Answer Sheet
for
MILK PROCESSING PLANT EMPLOYEE

UNIT: Milk Processing Equipment

TOPIC. Sanitary Pumps

1. For the moving of milk and dairy products

2. Centrifugal pumps and positive displacement pumps

3. A high speed impeller pumps the product

4 Flexibility and ability to handle all kinds of liquids even if the liquid contains suspended matter, variations in flow may be obtained, and the valve may be shut off without injury to the pump

5. Piston, gear, and lobe (or impeller)

6. Where high pressure is needed, generally in homogenizers

7. The internal gear teeth type--the milk is forced between the teeth and then discharged In the external gear teeth type the milk flows between the gear teeth and the housing.

8. Impellers are dynamically balanced and do not mesh

9. Rotation may be reversed and a smooth, virtually non-pulsating flow

10. Completely taken apart and cleaned

11. Because of abrasive materials removed from the lines which may cause excessive wear

12. Any nick to covers, rotors, or body may change the clearances causing a loss of pump efficiency

13. Rubber rotors are less subject to damage during the cleaning operation

14 Operates through a wide range of temperatures, handles gases and solids well, and is self priming

Answer Sheet
for
MILK PROCESSING PLANT EMPLOYEE

UNIT: Milk Processing Equipment

TOPIC: Receiving Equipment

1. Bulk and cans
2. The elimination of can washers, weigh cans, receiving vats, and scales
3. On the farm
4. Weighing, volumetric measuring, and meter flow pumps
5. By tank trucks
6. To make possible a continous receiving operation
7. Permit speed, sufficient capacity, rapid drain, 3-A sanitary standards, provide proper mixing of milk
8. To avoid delay and prevent overflow of milk
9. By hand or vacuum sampler
10. Simple, direct, free from trouble, proper elevations, correct speed, easy to clean, and easy to lubricate

Answer Sheet
for
MILK PROCESSING PLANT EMPLOYEE

UNIT: Milk Processing Equipment

TOPIC: Milk Tanks

1. Cooling and storing

2. Stainless steel inner shell, a layer of insulation, an outer jacket, and necessary fittings for inspection, control, and cleaning

3. 18-8 (18% chromium and 8% nickel) with a No. 4 mill finish

4. 2" thickness of cork, styrofoam, fiber glass or equivalent type insulation

5. Man hole cover

6. Improve cooling efficiency, uniformity of composition of the milk

7. A large vertical cylinder, consisting of an inner stainless steel liner, insulation, and outer jacket of carbon steel. It resembles the large type common farm silo.

8. By mechanical cleaning-in-place system

9. Air and mechanical

10. Effective and efficient circulation cleaning, expansion of walls, wind load, inner tank must support internal pressure of product, all parts free of distortion, tank supports carry load of tank and product

11. a. Inadequate venting
    b. Failure to open man hole door before cleaning
    c. Freezing of vent lines
    d. Overfilling tank and creating pressure

12. A continuous filling will cause excessive pressures inside the tank.

13. 40^{o}F., or lower

Answer Sheet
for
MILK PROCESSING PLANT EMPLOYEE

UNIT: Milk Processing Equipment

TOPIC: Filters and Clarifiers

1. To remove dirt and other extraneous matter
2. Will contribute to sediment in homogenized milk
3. By clarifiers
4. Cold milk and warm milk filters
5. To keep fine sediment from being forced through
6. So that frequent shutdowns to change filters are eliminated
7. Centrifugal force
8. 2 to 8 hours on cold; 1 to 4 hours on warm
9. 1963
10. 60,000 pounds per hour
11. 1 to 2 gallons
12. Non-gumming light oil

Answer Sheet
for
MILK PROCESSING PLANT EMPLOYEE

UNIT: Milk Processing Equipment

TOPIC: Separators and Homogenizers

1. Clarifiers remove dirt and extraneous materials; separators separate cream from the milk

2. Warm milk and cold milk

3. 110 - 120°F.

4. .01% fat

5. 25,000 pounds per hour for warm milk

6. 40°F.

7. .01%, Babcock

8. The smallest fat globules are so cold that their specific gravity is near that of skim milk and will not separate out.

9. To clarify and standardize the fat content of whole milk

10. a. Between two storage tanks
    b. Between tank truck and storage tank
    c. Between storage tank and vat
    d. Between storage tank and balance tank of high temperature-short time pasteurizer
    e. Between regenerative and heating sections of HTST pasteurizer

11. Clarifying, standardizing, or separation of milk

12. To product homogeneous emulsions of the product

13. By restricting the product flow area

14. From very small to 16 microns in size

UNIT: Milk Processing Equipment
TOPIC: Separators and Homogenizers
(Answer Sheet continued)

15. a. Turn on water to lubricate and cool
    b. Check pressure control for proper idling position
    c. Note if product is available
    d. See that product is diverted until proper pressure is obtained

16. a. Start motor
    b. Adjust to proper pressure
    c. Check for leaks

17. a. Divert liquid flow before pump is dry
    b. Release pressure
    c. Stop motor
    d. Shut off piston-lubricating water

18. a. Excessive leakage
    b. Fluctuating pressures
    c. Knocking sound
    d. No or intermittent flow

Answer Sheet
for
MILK PROCESSING PLANT EMPLOYEE

UNIT: Milk Processing Equipment

TOPIC: Heating, Holding, and Cooling Equipment

1. a. Continuous-flow heaters and coolers
   b. High-temperature short-time pasteurizers
   c. Steam heating and vacuum treating equipment
   d. Batch pasteurizers
   e. Ultra high temperature pasteurizing equipment

2. a. Barrel type tubular
   b. Internal tubular
   c. Surface
   d. Plate type

3. Stainless steel

4. The product is either pumped through or over heated coils.

5. The product is under pressure.

6. 161°F.

7. Uniform milk flavor thorugh the year

8. Low-pressure evaporation of water in the vacuum chamber

9. Low volume operations

10. 200°F.

Answer Sheet
for
MILK PROCESSING PLANT EMPLOYEE

UNIT: Milk Processing Equipment

TOPIC: Sanitary Thermometers and Gauges

1. They act as extensions of human sensing and provide accurate accounting of physical properties.

2. A device which senses a physical condition of a process and produces a useful signal

3. a. Circular chart recorders
   b. Strip chart recorders
   c. Multi-point recorders

4. a. On-off
   b. On-off differential gap
   c. Proportional
   d. Proportional pulse reset

5. a. Mercury thermometers
   b. Bimetal thermometers
   c. Capillary type thermometers
   d. Recording thermometers
   e. Thermocouples
   f. Resistant type elements
   g. Thermistor type elements

6. Safety protection and process control

7. a. Direct actuated sanitary gauge
   b. Filling system sanitary pressure measurement

8. Dead weight tester

9. Low pressure tank gauging

10. Determines liquid levels of the product

UNIT: Milk Processing Equipment
TOPIC: Sanitary Thermometers and Gauges
(Answer Sheet continued)

11. a. Mechanical scales
    b. Electronic tank scales
    c. Conveyor scales

12. a. Positive displacement meters
    b. Turbine meters
    c. Float type meters
    d. Timed flow meters
    e. Magnetic meters

13. Flow measurements, flow rates, or flow totalizing

Answer Sheet
for
MILK PROCESSING PLANT EMPLOYEE

UNIT: Milk Processing Equipment

TOPIC: Automatic Controls

1. a. Direct operated (self acting)
   b. Compressed air

2. A bulb partly filled with a volatile liquid, when heated or cooled, produces pressure within the bellows, causing the free end to move, operating the valve.

3. Keep packing in good condition, keep valve stem well lubricated, keep corrosion off exposed parts, keep connecting tube free of sharp bends, keep strainer in air line clean.

4. a. Air-to-open
   b. Air-to-close

5. a. Leaking rubber diaphragm
   b. Loose packing
   c. Leaking around valve disk
   d. Lubrication of valve stem

6. Bottle washers, milk pre-heaters, water jackets, vat pasteurizers, and cooling tanks

7. Steam pressure lines and pasteurizer milk flow lines

8. a. Clean air filters daily
   b. Clean air relay valves
   c. Check accuracy of safety thermal limit recorder
   d. Check condition of rubber ringer in flow valve
   e. Check diaphragm-operated valve
   f. Air supply pressure is correct
   g. Examine all pipe for leaks

Answer Sheet
for
MILK PROCESSING PLANT EMPLOYEE

UNIT: Milk Processing Equipment

TOPIC: Fillers and Sealers

1. Fill containers with the product and seal the product in the container
2. Gravity flow, and vacuum
3. Drive, bowl, filler valves, carrier, capper, and starwheels
4. By a float valve
5. Slow filling speed
6. A pipe supplies milk to a sealed bowl with a float valve. Air is drawn from the sealed bottle, drawing milk into the bottle. Milk and foam in the vent tube are drawn into the tank when the contact to the bottle is broken.
7. "Made-up" and "form and fill"
8. 100,000
9. Parafin or plastic
10. Must be kept cold to prolong life of container; rough handling will cause leaks.
11. Returnable and non-returnable
12. Yes, with some modifications
13. 2, 3, 5, and 6 gallon capacity
14. a. High sanitation
    b. Reduced weight of container

Answer Sheet
for
MILK PROCESSING PLANT EMPLOYEE

UNIT: Milk Processing Equipment

TOPIC: Conveyors

1. Gravity and power-chain driven

2. Moisture causing rust

3. Cases, cans, and similar items

4. a. Select proper conveyor
   b. Proper pitch
   c. Use of water-repellent grease
   d. Keep conveyors clean

5. Overcome difficulties in grade, suitable levels for various operations of inspection, filling cases, washing bottles, dumping cans, loading and unloading of trucks, and providing necessary timing for coordination of the plant

6. a. Pin type
   b. Ball and socket type
   c. Slat type
   d. Chain type

7. a. Side driven
   b. Overhead
   c. Underneath

8. a. Drag stack
   b. Pallet
   c. Unitized

9. They combine two lines into one for accumulation of 6 to 8 stacks.

10. a. Case stops
    b. Mechanical 2 into 1 combiners
    c. Sorting devices
    d. Pusher devices

11. Conveyor chains, gear reducers, and drive units

12. Soap

Answer Sheet
for
MILK PROCESSING PLANT EMPLOYEE

UNIT: Milk Processing

TOPIC: Receiving, Filtering, and Clarifying Milk

1. Can and bulk
2. 40°F. and below
3. "Drive-through" and "back-up"
4. Pumped through lines
5. Into weigh tanks
6. To remove dust or sediment from the milk
7. Unsanitary conditions
8. Mechanical clarifier
9. No
10. One which removes dirt and sediment and a portion of the cream to give all the milk a constant butterfat test

Answer Sheet
for
MILK PROCESSING PLANT EMPLOYEE

UNIT: Milk Processing

TOPIC: Common Pasteurization Methods

1. Exposure to heat to kill al pathogenic organisms

2. a. Slow requires 140°F. for 30 minutes
   b. Flash requires 161°F. for 15 seconds

3. 40°F.

4. Batch, high-temperature short-time, steam heating and vacuum treating, and ultra high temperature

5. 3 to 8 seconds at 265° - 285°F.

6. It provides a longer shelf life for fluid milk.

Answer Sheet
for
MILK PROCESSING PLANT EMPLOYEE

UNIT: Milk Processing

TOPIC: Other Methods of Pasteurization

1. Canning the milk in a high temperature, short-time sterilization process

2. 425°F.

3. Electron beams from a Van de Graaf generator, and gamma rays from a radioisotope, such as cobalt 60

4. In most tests, there were none. In one, rats did develop heart lesions.

5. Changes in flavor, color change, texture changes, milk jells in storage, and destruction of vitamins

6. Slow and not adaptable to large scale operations

7. Increases the Vitamin D content

8. In remote countries where milk quality is very poor, a grade of hydrogen peroxide, free of the poisonous metal barium, is used as a preservative.

9. By heating the milk

10. Removal of bacteria by centrifugal process

11. Where raw milk reaches more than 20 million bacterial count

12. The milk flows between two carbon electrodes, completing the electrical circuit, and heat is liberated directly into the milk.

13. Milk bottles are heated and steam sterilized, previously heated milk is added, the bottles are capped and then placed in 147°F. water for 30 minutes.

14. Difficulty of heating and cooling adds to cost of pasteurization and possibly not all the milk is heated to the proper temperature

Answer Sheet
for
MILK PROCESSING PLANT EMPLOYEE

UNIT: Milk Processing

TOPIC: Homogenization of Milk

1. Milk that has had the fat globules broken into smaller globules so they will not rise to the top
2. To keep a cream line from forming on the milk
3. By forcing the milk through a small valve opening under high pressure
4. 2000 to 3000 pounds per square inch (p.s.i.)
5. Low bacterial count, lowered curd tension, and improved keeping quality
6. Becomes rancid in flavor very quickly
7. Develops "activated" flavors
8. Foreign material, leucocytes, and cells
9. Clarification after homogenization
10. It reduces the viscosity by disrupting the clumps of fat first formed.

Answer Sheet
for
MILK PROCESSING PLANT EMPLOYEE

UNIT: Milk Processing

TOPIC: Filling Containers

1. Gravity-flow and vacuum filler

2. Vacuum

3. The circular bowl receives the milk, and filling valves attached to the bottom of the bowl release the milk when the star wheel brings the bottle under the valve.

4. A sealed bowl has a 13 inch vacuum on the milk. When the bottle comes in contact with the valve, it seals off the bottle and milk is pulled into the bottle.

Answer Sheet
for
MILK PROCESSING PLANT EMPLOYEE

UNIT: Milk Processing

TOPIC: Milk Storage

1. 5 to 6 days
2. Presence of psychrophilic bacteria
3. Yes
4. Water and unsanitized equipment
5. Organisms multiply more rapidly and contribute to early spoilage.

Answer Sheet
for
MILK PROCESSING PLANT EMPLOYEE

UNIT: By-Products and Specialties

TOPIC: Cultures - Fermented Milk Products

1. Buttermilk, cultured (sour) cream, half and half, cottage cheese, cream cheese, yogurt, and acidophilus milk, vulgaricus milk, kafir, kumiss

2. Careful control of fermentation through the use of lactic cultures

3. Whole milk, skim milk, cream, or mixtures thereof in combination with bacterial starters

4. Lactic acid

5. From commercial laboratories as liquids or powder

6. a. Use high quality milk
   b. High solids content non-fat
   c. High activity of culture
   d. Clean, sterile utensils
   e. Clean isolated rooms for mother cultures
   f. Clean operating personnel
   g. Strict control of temperature and acidities
   h. Extreme care to avoid contamination

7. Quaternary ammonium compounds and antibiotics

8. Bacteriophage

9. By attacking and destroying the bacteria cells

Answer Sheet
for
MILK PROCESSING PLANT EMPLOYEE

UNIT: By-Products and Specialties

TOPIC: Skim and Buttermilk

1. That portion of milk that remains after the cream has been removed
2. Fat and fat soluble vitamins
3. Used as skim milk, manufacture of cheeses, casein, sugar milk, non-fat dry milk, for baking, confectioners, and ice cream
4. 3.68%
5. A & D
6. Albumin, lactose, minerals
7. Liquid that remains after the removal of the fat in the churning of butter
8. 3.45%
9. That product obtained by churning sour cream or milk; it contains particles of butter
10. By spraying melted butter on the surface of agitated buttermilk

Answer Sheet
for
MILK PROCESSING PLANT EMPLOYEE

UNIT: By-Products and Specialties

TOPIC: Special Milks and Drinks

1. Fortified skim milk, soft-curd milk, chocolate milks and drinks, fresh concentrated milk, sterilized milk, frozen milk, egg nog drink, low sodium milk, multi-vitamin milk, and immune milk

2. Dietary authorities and medical professions

3. By addition of enzymes such as rennet

4. More readily digested than high tension milk

5. a. Heat treatment
   b. Homogenization
   c. Base-exchange treatment
   d. Enzyme treatment
   e. Addition of salt

6. Chocolate milk must meet the minimum butter fat requirements, chocolate drink can be made from skim milk not having a butter fat content

7. Sugar, cocoa or chocolate, suspending agent or stabilizer, vanilla, and salt

8. Milk chocolate flavor, no sediment, no ragged dark colored cream layer, low to medium to high sweetness

9. Milk that has been condensed 3 to 1, homogenized, and pasteurized for immediate consumption

10. Sterilized milk is used in remote areas when refrigeration is a problem.

Answer Sheet
for
MILK PROCESSING PLANT EMPLOYEE

UNIT: By-Products and Specialties

TOPIC: Cream

1. a. Light table or coffee cream 18 to 30% butterfat
   b. Light whipping 30 to 36% butterfat
   c. Heavy whipping or pastry - minimum 36% butterfat

2. The butterfat is lighter than the milk solids.

3. By the cream separator

4. Conical-shaped discs traveling at 3,000 to 20,000 r.p.m. force the lighter cream to the center of the bowl to flow out through a hole while the skim milk is pulled outward by centrifugal force and flows out.

5. 0.02 to 0.05%

6. Down to two microns in diameter

7. a. 90°F.
   b. 50° to 60°F.

8. 170-175°F. for 16-20 seconds

9. Rough-textured cream showing a cream plug in the bottle, or "oiling-off" in coffee

Answer Sheet
for
MILK PROCESSING PLANT EMPLOYEE

UNIT: By-Products and Specialties

TOPIC: Concentrated Milk Products

1. Fresh concentrated, evaporated, sweetened condensed

2. Grade A milk is clarified, standardized to 3.5% butterfat, pasteurized at 180°F. for 16 seconds, homogenized at 2500 pounds pressure, cooled to 125°F. and evaporated to 3.1 concentration. It is then repasteurized, cooled and bottled.

3. 60%

4. Unsweetened condensed milk

5. Clarify or filter milk, standardize to desired ratio of solids to fat. Heat to 190° to 210°F., increase temperature to 248° to 284°F. for 25 seconds, draw into a vacuum pan where the water is condensed off, then homogenize at 4000 pounds pressure.

6. Adjust the "salt balance."

7. Disodium hydrogen phosphate or calcium chloride

8. After it is canned and sealed

9. Indefinitely

10. Skim milk that has had coconut fat or other vegetable fat added in place of milk fat

11. Quality milk is fore-warmed for 15 to 30 minutes at 180° to 200°F.; a syrup containing 65% sucrose (sugar) is added at 190°F. The mixture is then evaporated to a ratio of 2:5:1. The milk is then cooled to 80° to 86°F. for 15 to 20 minutes and seeded with a small amount of dry skim milk powder to form a nuclei to develop small sugar crystals.

Answer Sheet
for
MILK PROCESSING PLANT EMPLOYEE

UNIT: By-Products and Specialties

TOPIC: Ice Cream and Related Products

1. Cream, milk, sugar, flavoring, stabilizer, emulsifier, egg yolk, and condensed or dry non-fat milk solids

2. Fat

3. Cream, milk, sweet butter, butter oil, or frozen cream

4. Milk, condensed skim milk, cream, or dry non-fat milk

5. Flavor

6. Sweetness, lower freezing point

7. a. Pasteurizing
   b. Homogenizing
   c. Aging the mix
   d. Freezing

8. 220 to 300°F. for 30 seconds

9. To permit clumping of fat globules to increase viscosity for quicker freezing and better body and texture

10. Batch and continuous ice cream freezer

11. 21° to 24°F.

12. To form a gel which improves the body and allows formation of large ice crystals

13. Influence body and texture, made product dry and stiff, and reduce whipping time

14. To keep from freezing to a hard or soggy mass

15. Loss of air and decrease in volume

16. Sandy ice cream is caused by the crystallization of milk sugar.

Answer Sheet
for
MILK PROCESSING PLANT EMPLOYEE

UNIT: By-Products and Specialties

TOPIC: Dry Milk Products

1. Drum or roller drying and spray drying

2. Preserve the milk for future use

3. Malted milk

4. Open (atmospheric) and vacuum

5. Internally heated drums turn, picking up a thin film of the evaporated milk placed in the trough; as the drum revolves, the thin film drys on the heated drum; a scraper blade removes the dry product which falls into a hopper where it is ground into powder.

6. 6 to 30 seconds at 200° to 300°F.

7. A fine stream of condensed milk is sprayed through a stream of heated air (150° to 380°F.) and the vaporized water is carried off leaving a tiny, hollow sphere of dry milk which falls to the bottom.

8. They are limited

9. 72%

10. Pelple have unfavorable reactions to the term skim milk.

11. Permits further crystallization of the lactose particles which keeps the product from caking when it is packaged

12. a. Preparation of malt extract
    b. Mixing and drying of extract with milk

13. Barley and wheat

Answer Sheet
for
MILK PROCESSING PLANT EMPLOYEE

UNIT: By-Products and Specialties

TOPIC: Butter and Margarine

1. Milk fat, buttermilk, water, salt, and added color

2. a. Cream is graded
   b. Neutralized if sour
   c. Standardized and filtered
   d. Pasteurized
   e. Cooled
   f. Churned

3. Stainless steel cylinder, rotated on a horizontal axis, with shelves on the interior walls to provide necessary working of cream

4. 40 to 45 minutes

5. The quick forming of the butter near the end of the process

6. A kneading process to force the butter granules into a compact mess

7. Pasteurized cream of 40 to 45% fat enters a 45 to 50^{o}F. cooled cylinder where high-speed dashers churn it into butter in about 1.5 seconds making it a continuous operation.

8. Weight of butter from a given lot of cream exceeds the amount of fat in the cream due to the presence of water, salt, and curd in the butter

9. Carotene

10. 3,400

11. Crumbly, gummy, leaky

12. a. Contamination by yeasts and molds
    b. Flavor and aroma
    c. Bacterial defects
    d. Surface taint

13. -10^{o} to -20^{o}F.

14. Vegetable fats are mixed with ripened skim milk to obtain an emulsion; this emulsion is chilled and kneaded in high-speed machines to a solid mass.

Answer Sheet
for
MILK PROCESSING PLANT EMPLOYEE

UNIT: By-Products and Specialties

TOPIC: Cheeses

1. 18
2. Texture and manner of ripening
3. 45 to 80% moisture
4. Most of the fat and protein
5. Cheddar
6. Hard and semi-hard
7. Pathogenic organism will not survive the aging process
8. Used as a bactericide
9. Acidity formation by desirable organisms causes coagulation and inhibits growth of undesirable organisms
10. Causes curdling
11. Causes milk to "set" with a firm curd
12. Whey determines the amount of acidity which controls the kind of cheese that will be produces.
13. Influence the activity of organisms and moisture of the cheese
14. During processing, during curd, rubbed on surface and soaked in brine water
15. "Green" or "uncurd"
16. Changes flavor, body, texture, and color
17. Bitter, acid, salty, fruity, and sulfide

Answer Sheet
for
MILK PROCESSING PLANT EMPLOYEE

UNIT: By-Products and Specialties

TOPIC: Cheddar and Cottage Cheese

1. Cheddar

2. Milk is heated to 87°F., and .5 to 2.5% volume of starter is added to obtain growth of lactic acid-forming organisms. When 0.2% acid, rennet is added to coagulate the milk. (Color is also added). When the milk "sets" into a solid curd it is cut into 1/2 inch cubes which are kept floating in the whey. It is then heated to 100°F. and the whey is drained off. The spongy mass is cut by milling, and salt is added which hardens and shrinks the curd. The curd is then cooled and bandaged for ripening.

3. Colby, granular, pineapple, monterey, high-moisture jack, washed curd, rindless

4. 6

5. Oxidation of fat, giving a tallowy flavor

6. Acid curd and rennet curd

7. 5-6 hours

8. Two hours after cutting

9. To remove the acid and increase its firmness and mild flavor

10. After it has been washed and creamed

Answer Sheet
for
MILK PROCESSING PLANT EMPLOYEE

UNIT: By-Products and Specialties

TOPIC: Process and Swiss Cheese

1. The mixing and grinding together of different lots of cheese with the aid of heat and an emulsifying agent
2. Cheddar, Swiss, Limburger, Brick, Camembert
3. The cheese is ground and heated in a steam cooker, where water, color and an emulsifying agent is added.
4. Acetic, citric, lactic, or phosphoric acid
5. 150°F. for 30 seconds
6. Food products, such as, cream, milk, skim milk, whey, fruits, vegetables, and meats
7. 44% to 60%
8. "Eyes"
9. Sweet, milk, nut-like flavor
10. Reduction of "set" or number of "eyes" that develop
11. Copper kettles
12. To form acid and make the "eyes"
13. Rennet
14. Carbon dioxide

Answer Sheet
for
MILK PROCESSING PLANT EMPLOYEE

UNIT: By-Products and Specialties

TOPIC: Other Varieties of Cheese

1. Roquefort type made in the U. S.

2. America

3. Fresh, pasteurized milk

4. The "set" milk is cut and heated to 115°F., the whey is drained and the curd is placed in a square mold to drain The cheese is then rubbed with salt and cured at 60°F. during which time a reddish-brown growth develops on the surface. After two weeks it is dipped in paraffin and wrapped in parchment for ripening

5. France

6. Sharp

7. Penicillium camemberti

8. Enzymes from the molds

9. By grinding and mixing together varieties of cheese without heat

Answer Sheet
for
MILK PROCESSING PLANT EMPLOYEE

UNIT. Plant Equipment Maintenance

TOPIC: Uses of Steam and Hot Water

1. Processing, cleaning and sanitizing, and space heating

2. Two to eight pounds

3. Heating of water in a steam generator

4. Determination of all the load conditions

5. The amount of heat required to raise one pound of water 1° F.

Answer Sheet
for
MILK PROCESSING PLANT EMPLOYEE

UNIT: Plant Equipment Maintenance

TOPIC: Hot Water Requirements

1. Cleaning equipment and wash rooms
2. Near the steam boiler
3. During cleaning operations
4. To provide load equalization and hot water when generators are shut down
5. Twelve g.p.h.
6. 300 g.p.h.
7. In a tank with steam coils

Answer Sheet
for
MILK PROCESSING PLANT EMPLOYEE

UNIT: Plant Equipment Maintenance

TOPIC: Boilers

1. Water-tube and fire-tube

2. Water is heated inside the tube by application of heat on the outside of the tubes

3. Water is heated inside the shell by applying heat to the outside of the shell and to the inside of tubes within the shell

4. a. Conveyed to water in boiler
   b. Lost in waste gases through the chimney
   c. Dissipated by radiation into the installation

5. a. Boiler design and cleanliness of heating surface
   b. Burner design and adjustability for proper air-fuel ratios.

6. Remove all scale, oil, foreign matter, and be sure gaskets are in good condition and properly sealed.

7. Be sure all damper and draft doors are open, and furnace is well ventilated.

8. Cut-in only when pressure is exactly equal with steam main. Shut off if unusual jar is heard.

9. Determine and remove cause even if it is necessary to cool the boiler.

10. Date and operating pressure of each test

11. Quality of water

12. Cause over heating and bulging of furnace plate

13. Each year

14. None

15. Corrosion from flue gases

16. Daily log

UNIT: Plant Equipment Maintenance
TOPIC: Boilers
(Answer Sheet continued)

17. To prevent formation of scale, corrosion, pitting, foaming, priming and brittleness

18. Impurities in the water

Answer Sheet
for
MILK PROCESSING PLANT EMPLOYEE

UNIT: Plant Equipment Maintenance

TOPIC: Water Sources and Conservation

1. Soft, cold, free from impurities
2. Rain and snow
3. Collects foreign materials
4. Calcium bicarbonate
5. Municipal water furnished by the city
6. Public supply too expensive
7. Increasing cost of water and the cost of disposal of liquid wastes

Answer Sheet
for
MILK PROCESSING PLANT EMPLOYEE

UNIT: Plant Equipment Maintenance

TOPIC: Water Impurities

1. To determine the kind of treatment needed to provide ideal water
2. The kind of water available
3. Properly located, protected, operated and easily accessible, adequate, safe and sanitary
4. Wastes, sulfides, algae
5. Marsh water, algae, gases
6. Filtered through activated carbon
7. Sedimentation, gravity or pressure type filters
8. Hard water, water spots, and fast build up in boiler tank
9. Undesirable color and flavor, and tend to discolor and corrode metals
10. Calcium, magnesium, and other metal salts present in water

Answer Sheet
for
MILK PROCESSING PLANT EMPLOYEE

UNIT: Plant Equipment Maintenance

TOPIC: Filters, Chlorination, and Corrosion

1. To prevent "fouling" of the filter

2. 12 gallons per minute per square foot

3. Two to three gallons per minute per square foot

4. Sand grains becoming coated and cemented together with silt

5. Removes the last trace of suspended matter

6. Cellulose acetate or special material such as cotton, glassfibre, Dynel, Orlon, Nylon

7. Activated carbon

8. By a surface contact phenomenon where the surface of the innumerable pores in the carbon particles trap the taste and odor producing particles

9. Disinfection of the water

10. Gas, liquid, powder

11. Dissolved gases, temperature, velocity, galvanic couples, and dissolved minerals

12. Aeration and combining with other materials to form inert compounds

Answer Sheet
for
MILK PROCESSING PLANT EMPLOYEE

UNIT: Plant Equipment Maintenance

TOPIC: Corrective Water Treatment

1. Its usage

2. Zero

3. Lower operating cost

4. Lime-soda

5. Base exchange through a bed of zeolite

6. Zero

7. a. First layer - bottom of coarse gravel
   b. Second layer - Fine gravel
   c. Third layer - Coarse sand
   d. Fourth layer - Zeolite bed

8. Re-formation of the spent zeolite

9. Calcium, magnesium, sodium, and potassium

10. Cation exchange (sodium cycle) followed by anion exchange (chloride cycle)

Answer Sheet
for
MILK PROCESSING PLANT EMPLOYEE

UNIT: Plant Equipment Maintenance

TOPIC: Pumps and Piping

1. Centrifugal, rotary, reciprocating
2. There are no close clearances
3. Regenerative and diffuser
4. By putting the product through a series of impellers
5. Particles of dirt will wear the close fitting parts
6. Wear of close fitting parts
7. Vapor bubbles forming when pump operates beyond its critical capacity
8. Destruction of the pump
9. Fresh water, milk sweet water, brine circulation hot water circulation, cleaning solutions, waste water, sewage, boiler feed water, condensation return, gasoline, and other movements of liquids
10. Periodic inspection, and replacement of worn or clogged parts
11. Steel and copper
12. Insulate pipe

Answer Sheet
for
MILK PROCESSING PLANT EMPLOYEE

UNIT: Plant Equipment Maintenance

TOPIC: Air Compressors

1. Centrifugal, axial, positive-displacement, rotary, or reciprocating

2. Single stage compress final discharge pressure in one step; multi-stage require two or more steps to reach discharge pressure

3. They keep out oil vapors and odors.

4. To take care of demand without sharp pressure drops

5. To reduce the number of motor starts needed per hour

6. To reduce moisture in the compressed air

7. Operation of lifts, grease guns, and tools, and operation of spraying paint, insecticides and sanitizing solution. Operation of bottle or carton fillers and copper pasteurizer and control instruments, agitation of products, movement of liquids, blowing out milk lines and providing overrun in continous freezers.

8. Oil-free

9. a. Change crankcase oil
   b. Drain air storage tank
   c. Clean compressor valves
   d. Clean intake filters
   e. Any other special precautions applying to one's compressor

Answer Sheet
for
MILK PROCESSING PLANT EMPLOYEE

UNIT: Electrical Power and Refrigeration

TOPIC: Terminology and Requirements

1. Electrical power from local service company

2. Home generator powered by gas, steam, or diesel engines

3. a. Dependability
   b. Quality of service
   c. Adequate capacity

4. a. Amount of current sent by a pressure of one volt through a resistance of one ohm
   b. Maximum or peak requirement in kilowatts of the whole plant
   c. One kilowatt equals 1000 watts
   d. Kwh is one kilowatt supplied to a load for one hour
   e. Kilowatts of power required by the plant
   f. Unit of resistance--one ohm will allow the flow of one ampere when one volt of pressure is applied
   g. The type of alternating current
   h. Unit of electro-motive force
   i. The product of volts and amperes in an alternating current circuit
   j. Unit of electrical power

5. a. Characteristics of power supply
   b. Electrical rates
   c. Demand-charge provisions
   d. Power factor provisions

6. Voltage, number of cycles, number of phases, and number of wires of the available supply

7. a. Amount of heat required to raise the temperature of one pound of water one degree Fahrenheit
   b. Sum of the gauge pressure plus atmosphere pressure
   c. Transfer of heat by movement of a gas or liquid
   d. Gas resulting from instantaneous evaporation of refrigerant
   e. Amount of heat absorbed by melting one pound of ice
   f. Heat given off or absorbed while a change in physical state of a material takes place
   g. Heat given off or absorbed during rise or fall of substance without change in physical state
   h. Ratio between the quantity of heat required to raise the temperature of a given weight on any substance $1^{\circ}F$. and 1 Btu.

Answer Sheet
for
MILK PROCESSING PLANT EMPLOYEE

UNIT: Electrical Power and Refrigeration

TOPIC: Wiring Materials and Controls

1. Safe, adequate, expandable, and efficient
2. Safety
3. "Underwriters Laboratories" (UL)
4. Provide safety
5. Wiring from the control box to the outlet and back
6. RW
7. When wire is subject to damage
8. Safety, prevent electrical shock, excessive operating cost, and unsatisfactory operation of equipment
9. Overload protection
10. Overload protection

Answer Sheet
for
MILK PROCESSING PLANT EMPLOYEE

UNIT: Electrical Power and Refrigeration

TOPIC: Electric Motors

1. Voltage, phase, cycles, power
2. Splash-proof
3. Fully enclosed, fan-ventilated
4. For immediate replacement
5. Exposed gears, chains, and belts

Answer Sheet
for
MILK PROCESSING PLANT EMPLOYEE

UNIT: Electrical Power and Refrigeration

TOPIC: "Sweet Water" and Brine Refrigeration Systems

1. Cool the products
2. Available at the proper temperature, is plentiful, low cost
3. Water which is reused in a closed water cooling system
4. Mechanical refrigeration or ice storage
5. Brine can be cooled below freezing point of water
6. Propylene glycol
7. Refrigeration compressor

Answer Sheet
for
MILK PROCESSING PLANT EMPLOYEE

UNIT: Electrical Power and Refrigeration

TOPIC: Mechanical Refrigeration Systems

1. Compressor, condenser, evaporator, liquid control valve
2. So it can be isolated for maintenance
3. High pressure, low pressure, oil pressure failure
4. Water or Brine chiller, ice builder, milk cooler, air cooler, freezer, or other types of freezers
5. In the low pressure receiver
6. Liquid will flash to a gas, reducing the capacity of the control valve and affects the performance of the evaporator
7. Ice cream operation

Answer Sheet
for
MILK PROCESSING PLANT EMPLOYEE

UNIT: Electrical Power and Refrigeration

TOPIC: Maintenance of Refrigeration Systems

1. A thorough knowledge of the system and its characteristics

2. Operation characteristics change

3. To avoid undue wear on the system or avoid inefficient operation

4. Use of pressure gauges and thermometers

5. Prolong the life and minimize expenditures for repairs

6. Protect equipment

Answer Sheet
for
MILK PROCESSING PLANT EMPLOYEE

UNIT: Plant Management

TOPIC: Product Losses and Records

1. Daily, constant attention

2. It is the most costly component of milk

3. Flow measurement, sampling in proportion to flow, analysis of floor waste

4. Inaccuracy in weighing, sampling, testing, separating, standardizing, leakage, spillage, drainage, breakage, theft, spoilage, evaporation, and employee use

5. a. Total purchased versus total accounted for
   b. Total purchased versus standards
   c. Usage versus daily production

Answer Sheet
for
MILK PROCESSING PLANT EMPLOYEE

UNIT: Plant Management

TOPIC: Operating Efficiencies and Production Schedules

1. Lack of thought, misinformation, and carelessness

2. More effective application of available resources and facilities

3. Savings realized from remodeling or building a new plant

4. Manpower reduced or production increased

5. Supervision, selection and training, employee suggestion system, working conditions and work simplification

6. Equipment layout, milk receiving operation, processing, filling, case handling, switches and hoses, hot water supply, cleaning operations, maintenance, scheduling, accounting, and others

7. Water, electricity, refrigeration, and steam

8. Storage and handling, cleaners and sanitizers, bottles, containers, caps and miscellaneous supplies

Answer Sheet
for
MILK PROCESSING PLANT EMPLOYEE

UNIT: Plant Management

TOPIC: Container Losses

1. Breakage
2. Stones and blisters
3. On the basis of an inspection
4. Dry and little temperature fluctuation
5. Scratching and etching of the glass
6. Heat, Pressure, Impact
7. Bottles piled on top of full cases
8. Inspect broken bottles
9. Number sold from number purchased
10. Weakens container wall to point of leakage

Answer Sheet
for
MILK PROCESSING PLANT EMPLOYEE

UNIT: Plant Management

TOPIC: Waste Prevention

1. a. Savings in dollars
   b. Compliance with stream pollution regulations
   c. Municipalities charge for waste disposal

2. Personal factor

3. Poorly maintained equipment, inadequately trained and poorly supervised personnel

4. Leakage

5. Product loss or spoilage

6. Repair or replace them

7. It contains a large amount of milk solids

8. To keep cracked bottles out of the filling line

Answer Sheet
for
MILK PROCESSING PLANT EMPLOYEE

UNIT: Plant Management

TOPIC: Waste Disposal

1. Not be dumped in the sewage system or into a stream

2. Skim milk, churn buttermilk, whey

3. a. Feeding to livestock
   b. Evaporated to condensed products
   c. Dried

4. To measure the flow of a liquid

5. Because the waste strength is variable

6. It provides a continuous sampling

7. a. Temperature
   b. pH
   c. Dissolved oxygen in ppm
   d. 5-day BOD
   e. COD (Chemical Oxygen Demand)

8. Passed through a combination of sand trap, fat trap, and screen tank

9. To catch fat and paraffin wax before it hits the screen

10. 3,600 to 30,000 gallons per acre per day

Answer Sheet
for
MILK PROCESSING PLANT EMPLOYEE

UNIT: Plant Maintenance

TOPIC: Painting

1. Keep plant attractive and protect building investment

2. Exposure to moisture, acid, and alkali

3. Acids, alkalies, moisture, and abrasions

4. Dry ceilings and walls, remove dirt, rust, grease, scale, loose paint, and brush clean

5. Brush and spray

6. Oil enamel, synthetic enamel, and vinyl plastic

7. Scheme for the identification of piping system

8. To protect the quality of the product

9. Improve visual condition, safety, and efficiency

Answer Sheet
for
MILK PROCESSING PLANT EMPLOYEE

UNIT: Plant Maintenance

TOPIC: Floor, Roof, and Walls

1. Concrete and tile
2. Concrete will pit and blemish
3. Acid-proof brick
4. Composition paper, metal, gravel, and cement
5. Application of high quality asbestos--asphalt roof coating
6. Rust-resistant paint
7. Cleaned and painted with mortar
8. When need develops
9. Recaulked and smoothed into place

Answer Sheet
for
MILK PROCESSING PLANT EMPLOYEE

UNIT: Plant Maintenance

TOPIC: Lighting, Ventilating, and Air Conditioning

1. Reduced breakage, improved cleanliness, better utilization of floor space, reduced eye strain, and increased safety

2. Such that the work can be done with ease, speed, and accuracy

3. Incandescent, fluorescent, or mercury vapor lights

4. Storage, loading, filling, refrigerator, receiving, laboratories, offices, storage tanks and vats, pasteurizers, instruments, and transportation tank areas need lighting

5. Provides pure air, of required standards to the various plant areas

6. 30 cubic feet

7. Smoke, gases, fur, feathers, fungi, insects, and insect parts

8. Stale air can affect the quality of the milk

9. Heating is part of ventilating and air conditioning system

10. .003 tons per square foot

11. Offices, laboratory, retail store, and driver's quarters

Answer Sheet
for
MILK PROCESSING PLANT EMPLOYEE

UNIT: Plant Maintenance

TOPIC: Lubrication

1. To reduce friction
2. Use of the right lubricant, at the right time, in the right way
3. Resistance of a fluid to flow
4. Oils, greases, solids
5. Proper viscosity, oiliness, resistance to vaporization, oxidation, acid and sludge formation, anti-rust, and foaming
6. Cling to and do not drip off of surface
7. Where temperatures are higher than the limits for grease and oils.
8. Sleeve and anti-friction
9. A "soup" will form and leak out
10. Motors, speed reducers, conveyors, chain drives, pumps, air compressors, refrigeration systems, clarifiers, separators, homogenizers, filling machines

Topic Test
on
SCOPE, TRENDS, AND OPPORTUNITIES

Student:____________________ School:____________________

Date:____________________ Score:____________________

Write True beside the statements that are true and False beside the statements that are false.

______ 1. Honey and milk are the only two foods whose sole function is to serve as a food.

______ 2. Milk is considered by all nutritionists as nature's most nearly perfect food.

______ 3. No other single substance can substitute for milk in the diet.

______ 4. Cow's milk is the only kind of animal milk used for human food.

______ 5. The United States ranks first in consumption of whole milk per capita in the world.

______ 6. Pasteurized milk loses one half of its food value.

______ 7. Milk is pasteurized to kill any pathogenic organisms that may be present.

______ 8. The dairy industry ranks tenth in the Unites States in importance.

______ 9. One-half of the milk produced in the United States is from farms in the southern part of the U.S.

______10. Nearly all of the veal produced in the United States comes from the sale of dairy calves.

Topic Test
on
JOB TRAINING AND ACCEPTANCE OF JOB SUPERVISION

Student:____________________ School:____________________

Date:____________________ Score:____________________

Answer the following questions:

1. What should initial training on the job cover?
2. Why is it necessary for a new employee to be trained in his new job?
3. Why is it necessary to have job supervision in the milk plant?
4. Why is it necessary to provide in-plant programs?

Topic Test
on
PLANT LAYOUTS

Student:______________________ School:______________________

Date:______________________ Score:______________________

Write True beside the statements that are true and False beside the statements that are false.

_______ 1. The three most important considerations of plant layout are function, expansion, and flexibility.

_______ 2. Professional service advice is not usually considered in plant layouts.

_______ 3. Plants are generally designed on the "U" product flow method.

_______ 4. Future production should be considered when planning a plant expansion program.

_______ 5. Parking requirements and truck traffic should be considered when planning the buidling program.

Topic Test
on
ACCIDENT PREVENTION AND FIRST AID

Student:____________________ School:____________________

Date:____________________ Score:____________________

Write True beside the statements that are true and False beside the statements that are false.

______ 1. Plant safety does not increase plant efficiency.

______ 2. Accident prevention is more costly than accident treatment.

______ 3. Accident records are of little value in preventing accidents.

______ 4. Regular inspection for accident hazards is a good safety step.

______ 5. Adequate lighting and ventilation are safety steps.

______ 6. Improper handling of milk can cause back injuries.

______ 7. The use of conveyors for handling empty cases will help to avoid back strain.

______ 8. Incoming cases need not be cleaned before storage.

______ 9. Splash-proof goggles provide good protection from caustic chemicals.

______10. It is not necessary to stop machinery to make adjustments.

Topic Test
on
SECRETION, COMPOSITION, AND PROPERTIES OF MILK

Student:______________________ School:______________________

Date:______________________ Score:______________________

Write True beside the statements that are true and False beside the statements that are false.

_______ 1. Most milk secretion takes place in the alveoli, located at the end of each branch of the duct system.

_______ 2. Milk secretion may be slowed or stopped by pressure of the milk in the alveoli and udder.

_______ 3. Hormones control milk "let down."

_______ 4. Only small amounts of blood passing through the udder are needed for high milk production.

_______ 5. Milk is not a complete food for most animals after they have grown past the suckling stage.

_______ 6. There is little variation in the composition of milk from various mammals.

_______ 7. Milk from a diseased cow may vary greatly from normal milk.

_______ 8. The mineral content of milk is fairly constant.

_______ 9. It is practical to change the color of milk by changing the cow's feed.

_______10. Compared to some other foods, the energy value of milk is low because of the high content of water.

Topic Test
on
MILK FAT

Student:______________________ School:______________________

Date:______________________ Score:______________________

Match the following:

_______	1.	Fatty	a.	Milk fat
_______	2.	Vitamin E	b.	Butyric
_______	3.	Higher digestibility	c.	Fat
_______	4.	Liquid	d.	Large globules
_______	5.	Lower Digestibility	e.	Lecithin
_______	6.	Jersey and Guernsey milk	f.	Low melting point
_______	7.	Cholesterol	g.	Oil
_______	8.	Solid	h.	High melting point
_______	9.	Globules	i.	Tocopherol
_______	10.	Phospholipide	j.	Sterol

Topic Test
on
MILK PROTEINS

Student:______________________ School:______________________

Date:______________________ Score:______________________

Fill in the blanks:

1. Proteins contain carbon, hydrogen, oxygen, and ______________.
2. The number of ________ ________ present determines the quality of proteins.
3. The principal protein of milk is ____________.
4. Casein is coagulated commercially by adding __________ or ________ to skim milk.
5. The desirable temperature range of the skim milk for rennet-casein is ________ to ________ degrees F.
6. Rennet-casein is used in the manufacture of ____________.
7. The principal commercial use of casein is in the manufacture of coating for ____________.
8. The proteins __________ and ____________ are retained in whey.
9. Unlike casein, lactalbumin is not coagulated by ____________.
10. There is a high content of globulins in ______________.

Topic Test
on
MILK SUGAR

Student: ______________________ School: ______________________

Date: ______________________ Score: ______________________

Write True beside the statements that are true and False beside the statements that are false.

_______ 1. Lactose is found in milk and in other natural foods.

_______ 2. The lactose content of cow milk is constant.

_______ 3. Lactose is usually prepared from whey.

_______ 4. Whey from sulphuric acid casein is ideal for lactose.

_______ 5. Crude lactose needs no further refining to be edible or to meet pharmaceutical standards.

_______ 6. Lactose is completely water soluble.

_______ 7. The formation of large crystals of lactose causes "sandiness" in some dairy products.

_______ 8. Lactose is used to modify cow milk for infant feeding.

_______ 9. Fermentation of lactose is the only commercial method of producing lactic acid.

_______10. Lactose is sweeter than sucrose.

Topic Test
on
MINERALS AND WATER IN MILK

Student:______________________ School:______________________

Date:______________________ Score:______________________

Write True beside the statements that are true and False beside the statements that are false.

_______ 1. The ash of milk is always alkaline in reaction.

_______ 2. Two major minerals in milk are calcium and potassium.

_______ 3. Milk has the ability to dissolve small amounts of many metals.

_______ 4. Milk contains more calcium per unit of dry matter than most other foods.

_______ 5. The calcium content of milk can be increased by feeding the cow a ration high in calcium.

_______ 6. It is generally said that one quart of milk per day will supply the calcium required by a growing child.

_______ 7. Milk from cows with diseased udders usually has a high salt content.

_______ 8. Copper and iron are soluble in milk.

_______ 9. Milk is high in iron content.

_______10. Zinc is readily dissolved by sour milk products.

Topic Test
on
VITAMINS IN MILK

Student: ______________________ School: ______________________

Date: ______________________ Score: ______________________

Match the following:

_______ 1. Water soluble
_______ 2. Niacin
_______ 3. Vitamin C
_______ 4. Cobalt content of feed
_______ 5. Off-flavor of milk
_______ 6. Carotene
_______ 7. May retard oxidized flavor
_______ 8. Riboflavin
_______ 9. Vitamin D
_______ 10. Milk is poor source

a. Vitamin A
b. Vitamin B_2
c. Folic Acid
d. Vitamin B Complex
e. Ascorbic Acid
f. Nicotinic Acid
g. Ultraviolet Light
h. Prevents Rickets
i. 20 Milligrams to the Quart
j. Affects Vitamin B_{12}
k. Thiamine
l. Vitamin B_1
m. 5 Milligrams per day

Topic Test
on
MICROBIOLOGY OF DAIRY PRODUCTS

Student:______________________________ School:______________________________

Date:______________________________ Score:______________________________

Write True beside the statements that are true and False beside the statements that are false.

_______ 1. A high bacterial count will result when milk is held at a warm temperature.

_______ 2. The bacterial count is usually expressed as the number of bacteria per milliliter.

_______ 3. Rapidly cooling milk as it is produced and storing it under refrigeration retards the growth of most micro-organisms.

_______ 4. All bacteria are harmful.

_______ 5. All bacteria are destroyed by pasteurization.

_______ 6. Yeasts are readily destroyed by pasteurization.

_______ 7. The presence of body cells in milk is normal.

_______ 8. The organisms that cause mastitis are not harmful to man and cannot be destroyed by pasteurization.

_______ 9. Milk normally contains several enzymes.

_______ 10. Certain processing operations make raw milk susceptible to lipase action and rancidity.

Topic Test
on
MILK AND DISEASES

Student:____________________ School:____________________

Date:____________________ Score:____________________

Match the following:

_______	1.	Prevents diseases	a.	Infected milk handlers
_______	2.	Raw milk	b.	Brucellosis
_______	3.	Air, dust, and manure	c.	Infectious jaundice
_______	4.	Whey test	d.	Pasteurization
_______	5.	Typhoid fever	e.	Botulism
_______	6.	Common source of contamination	f.	Source of diseases
_______	7.	Associated with Salmonella	g.	140 degrees F. for 2 minutes
_______	8.	Brucellosis	h.	Source of bacteria
_______	9.	Clostridium	i.	Food poisoning
_______	10.	Leptospirosis	j.	Undulant fever

Topic Test
on
ANTIBIOTICS, PESTICIDES, AND RADIOACTIVITY

Student:______________________ School:______________________

Date:______________________ Score:______________________

Write True beside the statements that are true and False beside the statements that are false.

_______ 1. The use of feed containing antibiotic supplements will not cause antibiotics to appear in the milk.

_______ 2. Some pathogenic bacteria may develop a tolerance for an antibiotic.

_______ 3. Antibiotics in milk do not affect processing procedures.

_______ 4. Milk containing any trace of an antibiotic is considered to be adulterated.

_______ 5. The heat treatment given milk during processing destroys all antibiotic activity.

_______ 6. There are quick, reliable, simple tests for detecting antibiotics in milk.

_______ 7. Any trace of a pesticide in milk constitutes adulteration.

_______ 8. The chlorinated hydrocarbon pesticides have been given the most attention in the dairy industry.

_______ 9. Pesticides are not transferred to the milk when consumed on forage that has been sprayed.

Topic Test
on
HOUSKEEPING PRINCIPLES

Student:______________________ School:______________________

Date:______________________ Score:______________________

Write True beside the statements that are true and False beside the statements that are false.

_______ 1. Poor housekeeping is usually an indication of carelessness in plant operations.

_______ 2. Good housekeeping is necessary for customer confidence in the plant and its products.

_______ 3. Lighting is not important in plant housekeeping.

_______ 4. The appearance of driveways, lawns, and shrubbery has little effect on plant housekeeping.

_______ 5. The receiving room is usually expected to be in poor condition because of the traffic.

_______ 6. An old building and poor equipment are valid reasons for poor housekeeping.

_______ 7. Cleanliness should be the sole responsibility of the plant supervisor.

_______ 8. Window sills are a good location for small, often-used equipment.

_______ 9. Good housekeeping leads to safer working conditions.

_______10. Every employee should have a clean uniform and cap every week.

Topic Test
on
CLEANING AND CARING FOR EQUIPMENT

Student:______________________________ School:______________________________

Date:________________________________ Score:______________________________

Match the following:

_______	1.	Dissolve milk proteins	a.	Acid solution
_______	2.	Rinse and wash water	b.	Detergent
_______	3.	O-R Cleaning	c.	Clean sanitary fittings
_______	4.	Dissolve milkstone	d.	Alkali added to acid
_______	5.	CIP	e.	Storage tanks
_______	6.	Homogenizer	f.	115 degrees F.
_______	7.	Wetting agent	g.	Alkaline solution
_______	8.	Spray cleaning	h.	Handle parts carefully
_______	9.	Metal sponges	i.	Recirculation
_______	10.	Motor driven brush	j.	Should not be used

Topic Test
on
SANITIZING DAIRY EQUIPMENT

Student:______________________________ School:______________________________

Date:______________________________ Score:______________________________

Write True beside the statements that are true and False beside the statements that are false.

_______ 1. Sanitizing should destroy all pathogenic organisms.

_______ 2. To be most effective, sanitizers should be used just prior to use of the equipment.

_______ 3. The type of construction of equipment does not affect proper sanitizing.

_______ 4. Only a small amount of hot water that is above 170°F. is required to sanitize equipment.

_______ 5. Live steam is always practical as a sanitizing agent.

_______ 6. The sanitizing efficiency of chlorine compounds is high.

_______ 7. Chemical sanitizers will destroy organisms imbedded in organic matter.

_______ 8. A hypochlorite solution should have a strength of not less than 50 ppm.

_______ 9. Chemical sanitizers should never be brushed on equipment.

Topic Test
on
CANS AND CAN WASHING

Student:____________________ School:____________________

Date:____________________ Score:____________________

Write True beside the statements that are true and False beside the statements that are false.

______ 1. The sanitary condition of cans has little bearing on the quality of milk and milk products.

______ 2. Aluminum cans are easily cleaned.

______ 3. Stainless steel cans eliminate many common problems.

______ 4. Cans with open seams can be properly cleaned.

______ 5. Empty cans should be stored with the cover in place to prevent dust from entering the can.

______ 6. Chlorine should not be used to sanitize cans.

______ 7. There are two main types of can washers.

______ 8. An acid or alkaline cleaning compound may be used in a mechanical can washer.

______ 9. Most mechanical can washers are self-cleaning.

______ 10. Using acid to remove scales from can washers should be practiced every other day.

Topic Test
on
BOTTLE WASHING

Student:______________________ School:______________________

Date:______________________ Score:______________________

Match the following:

_______ 1. Caustic

_______ 2. Soaker-type washer

_______ 3. Remove scale

_______ 4. Hand washing

_______ 5. Gear lubrication

_______ 6. Sodium hydroxide concentration

_______ 7. Pressure-type washer

_______ 8. Conveyor lubrication

_______ 9. Scale formation

_______10. Extra safeguard

a. Uneconomical

b. Hard water

c. Sterilizing power

d. Chlorination

e. Continuous run to filler

f. Oil or grease

g. Special soap

h. Bottle washing solution

i. Strong acid

j. Small plant

Topic Test
on
INSECT AND RODENT CONTROL

Student: ____________________ School: ____________________

Date: ____________________ Score: ____________________

Fill in the blanks:

1. The ____________________ is responsible for keeping insects and rodents out of the plant.

2. The clause in the Federal Food, Drug, and Cosmetic Act which allows the inspector to condemn the product without seeing the insect or rodent is called the "_______________" clause.

3. ________ and _______________ are the two common insects around the milk plant.

4. All openings should be covered with ____________ ____________ ____________ to prevent entry into the milk by insects.

5. By the use of a vestibule with an ______________ __________, entry through doors may be prevented.

6. The ______________________ Department of the State College of Agriculture will make recommendations of the proper insecticides to use at the milk plant.

7. Most insects can be satisfactorily controlled by control of their __________ and by the use of __________________.

8. For control of rodents all buildings should be _______________________.

9. Baiting of rodents should be done around the _______________ of the milk plant.

10. Rodent poisons are never used inside the plant because the rodents are likely to __________ anywhere in the plant causing contamination of the product.

Topic Test
on
GRADES AND CLASSES OF MILK

Student:________________________ School:________________________

Date:________________________ Score:________________________

Write True beside the statements that are true and False beside the statements that are false.

______ 1. The bacterial count is the only factor used to establish the sanitary quality of milk.

______ 2. Most city health departments have sanitary codes which cover the grading of milk.

______ 3. Inspectors supervise sanitary conditions in milk processing plants and on dairy farms.

______ 4. Milk and cream usually have the same bacterial count standards.

______ 5. The production of Certified Milk does not involve medical examination of the employees.

______ 6. Grade A Raw Milk for pasteurization may have a higher bacterial count than milk sold as whole Grade A Raw Milk.

______ 7. The only difference in Grade B and Grade A Pasteurized Milk is the bacterial-count standard.

______ 8. Grade C milk meets all requirements of Grade B milk except the bacterial-count standard.

Topic Test
on
FLAVOR AND PHYSICAL DEFECTS

Student:______________________ School:______________________

Date:______________________ Score:______________________

PART I: Write True beside the statements that are true and False beside the statements that are false.

_______ 1. The sense of touch is not important in appraising flavor of milk.

_______ 2. Milk will not absorb odors or off-flavors from the environment.

_______ 3. Exposure of milk to sunlight may induce an oxidized flavor.

_______ 4. Temperatures needed to properly pasteurize milk will cause a pronounced cooked flavor.

_______ 5. Foam in milk has no effect upon efficiency of pasteurization.

PART II: Match the following:

_______	1.	Bacterial origin	a.	oxidized flavor
_______	2.	Malty flavor	b.	feathering
_______	3.	Salty flavor	c.	sour or acid
_______	4.	Chemical change	d.	advanced lactation
_______	5.	Cream physical defect	e.	bacteria

Topic Test
on
SAMPLING

Student:______________________ School:______________________

Date:______________________ Score:______________________

PART I: Write True beside the statements that are true and False beside the statements that are false.

______ 1. Careful testing will make up for inaccurate sampling.

______ 2. Each lot of milk should be sampled and tested separately.

______ 3. Curdled, churned, or partially churned milk cannot be accurately sampled.

______ 4. Milk from producers is usually tested each day.

______ 5. Milk samples for judging flavor should be cold.

PART II: Fill in the blanks:

1. For representative samples, the milk must be __________ or __________.

2. Milk for a composite sample should have a ______________ added.

3. Automatic milk samplers work on the same principle as the __________.

4. Frozen or partly frozen milk should be thawed __________ before sampling.

5. The milk judge should rotate the container rapidly and quickly __________ the contents.

Topic Test
on
BACTERIOLOGICAL TESTS

Student:____________________ School:____________________

Date:____________________ Score:____________________

Write True beside the statements that are true and False beside the statements that are false.

_______ 1. The Standard Plate Count gives reliable results on milk that contains either many or few bacteria.

_______ 2. A colony may have developed form one organism.

_______ 3. Only one sample examination is needed to judge the quality of a given milk supply.

_______ 4. Pasteurization usually destroys less than 90% of the bacteria in raw milk.

_______ 5. The Standard Plate Count results are obtained within three hours.

_______ 6. The Direct Microscopic Count may be made without staining the slide film.

_______ 7. Dead micro-organisms may be stained and counted.

_______ 8. The microscopic count may be used to check for the presence of thermophilic organisms.

_______ 9. Dye Reduction tests measure the number of bacteria in the milk.

_______ 10. The Resazurin Reduction Method will detect the presence of colostrum.

Topic Test
on
BUTTERFAT TESTS

Student: ____________________ School: ____________________

Date: ____________________ Score: ____________________

Match the following:

_____	1.	Price to producers	a.	improper shaking
_____	2.	Meniscus	b.	levels off meniscus
_____	3.	Cream test	c.	small graduated neck
_____	4.	Butyl alcohol test	d.	butyrometer
_____	5.	Charred fat column	e.	fat content
_____	6.	Clymol	f.	evaporated milk
_____	7.	Test bottle for cream	g.	weight in grams
_____	8.	Skim milk	h.	larger neck
_____	9.	Gerber Test	i.	skim milk
_____	10.	Ether extraction	j.	fat column

Topic Test
on
SOLIDS-NOT-FAT TESTS

Student:______________________ School:______________________

Date:______________________ Score:______________________

PART I: Fill in the blanks:

1. The lactometer is a special form of ________________.

2. The Quevenne lactometer is used with milk at __________ °F.

3. The Watson lactometer is used with milk at __________°F.

4. Corrected readings of the Quevenne lactometer can be made at temperatures between _________°F. to _______°F.

5. A lactometer reading of 32 is a specific gravity of __________.

PART II: Write True beside the statements that are true and False beside the statements that are false.

_____ 1. A given milk sample will always have the same specific gravity.

_____ 2. A lactometer is read below the meniscus.

_____ 3. Total solids and solids-not-fat can be calculated by a formula or by using a nomograph.

_____ 4. A lactometer can be used to detect milk which has had water added to it.

_____ 5. The Gravimetric Test involves evaporation of the moisture content.

Topic Test
on
ACIDITY TESTS

Student:____________________ School:____________________

Date:____________________ Score:____________________

Write True beside the statements that are true and False beside the statements that are false.

______ 1. Fresh milk usually contains 0.3% lactic acid.

______ 2. Acidity expressed as % lactic acid is measured by titration.

______ 3. An alkali solution, 0.1 normal sodium hydroxide, is usually used to neutralize acid in titration.

______ 4. Phenolphthalein is colorless in alkaline solution.

______ 5. Phenolphthalein is pink in acid solution.

______ 6. A formula is not necessary to determine the percent acidity in titration.

______ 7. Lactic acid is formed by bacterial fermentation.

______ 8. A pH of 7 is neutral in reaction.

______ 9. A pH of 5 is alkaline in reaction.

______ 10. Milk contains substances that act as buffers.

Topic Test
on
MISCELLANEOUS TESTS

Student: ______________________ School: ______________________

Date: ______________________ Score: ______________________

Match the following:

_______ 1. Enzyme

_______ 2. Moisture evaporation in butter

_______ 3. Freezing point

_______ 4. Sediment test

_______ 5. Ether extraction

_______ 6. Phosphatase test

_______ 7. Sodium hydroxide

_______ 8. Sucrose test

_______ 9. Salt test in butter

_______10. 31°F.

a. Air pressure or vacuum

b. Titration

c. Fat content in butter

d. Phosphatase

e. Freezing point of milk

f. Amber-colored fat

g. Dietetic milk products

h. Proper pasteurization

i. Detect added water

j. Protein solubility

Topic Test
on
STANDARDIZING DAIRY ARITHMETIC

Student: ______________________________ School: ______________________________

Date: ______________________________ Score: ______________________________

Answer the following questions:

1. Standardization is necessary to obtain a uniform ________________________.
2. A simple method of standardizing milk or cream is called the ____________ ____________________.
3. Total solids and protein content have a definite relationship to the ________ ___________________.
4. What proportions of 28% cream and 3% milk are needed to prepare milk that contains 4% fat?
5. How many pounds of 32% cream and 3% milk are needed to prepare 600 pounds of 4% milk?

Topic Test
on
GRADES OF CREAM

Student:______________________ School:______________________

Date:______________________ Score:______________________

Write True beside the statements that are true and False beside the statements that are false.

_______ 1. The three grades of cream are light whipping, light or coffee, and heavy whipping.

_______ 2. Plastic cream is cream containing 65% to 85% fat.

_______ 3. Half-and-half is a mixture of 50% milk and 50% butterfat.

_______ 4. Feathering of cream is when thick cream floats on top of the cream bottle.

_______ 5. The cream line is the depth of the layer of unhomogenized cream.

_______ 6. The cream plug consists of the large fat globules which have floated to the surface of the cream line.

_______ 7. Slightly sour cream will feather very easily.

_______ 8. Sterilized cream has been available for canning only recently.

_______ 9. Manufacturing cream is made from Grade A milk.

_______10. During the separation of cream from milk, the line of dirt and scum collects inside the drum known as "separator slime."

Topic Test
on
EQUIPMENT LAYOUT

Student:______________________ School:______________________

Date:______________________ Score:______________________

Write True beside the statements that are true and False beside the statements that are false.

_______ 1. Packaging is influenced by the system of product distribution.

_______ 2. The processing equipment is not influenced by the packaging system.

_______ 3. Two feet is the generally accepted minimum distance between equipment and walls.

_______ 4. Limited access will influence loading and unloading.

_______ 5. Milk weighing facilities will always be required in the receiving room of all plants.

_______ 6. Storage tanks for raw milk should be close to the processing area.

_______ 7. Rectangular storage tanks are more costly than cylindrical tanks.

_______ 8. Standards of quality for by-products are not as important as for fluid milk.

_______ 9. The same dock should be used for receiving returned bottles, receiving milk, and loading out milk and products.

_______10. Crossing conveyors will not present any problem.

Topic Test
on
MATERIALS FOR DAIRY EQUIPMENT

Student:____________________ School:____________________

Date:____________________ Score:____________________

Write True beside the statements that are true and False beside the statements that are false.

______ 1. Metals for surfaces that contact milk and milk products should be easy to clean and keep bright.

______ 2. Nickel has excellent heat transfer characteristics.

______ 3. Tin is not affected by milk.

______ 4. The flavor of milk is affected by aluminum.

______ 5. The use of solder in dairy equipment is increasing.

______ 6. Stainless steel with higher finishes (highly polished) is easier to clean than that with lower finish.

______ 7. Stainless steel will not corrode.

______ 8. Acid or alkaline cleaners of high concentration may cause pitting of stainless steel.

______ 9. Chlorine compounds should be used on stainless steel just before the equipment is to be used.

______ 10. Rusty or pitted areas of stainless steel should be polished out with a scouring powder.

Topic Test
on
SANITARY PIPE AND FITTINGS

Student:______________________ School:______________________

Date:______________________ Score:______________________

Write True beside the statements that are true and False beside the statements that are false.

________1. Stainless steel sanitary pipe is used universally throughout the industry.

________2. Straight runs of piping should be supported every 10 feet.

________3. Stainless steel pipe will not corrode.

________4. Cleaning solutions will not harm stainless steel pipe.

________5. Glass piping will not withstand temperatures up to 212°F.

________6. Glass piping has the ability to absorb excessive vibration.

________7. Plastic tubing has proven adaptable for use on bulk tanker unloading.

________8. The dairy industry was the first to develop sanitary pipe and fittings.

________9. Sanitary fitting threads are wide and easy to clean.

________10. Very little maintenance is required for air-operated valves.

Topic Test
on
SANITARY PUMPS

Student:______________________ School:______________________

Date:______________________ Score:______________________

Answer the following questions:

1. What types of motors are generally used on centrifugal sanitary pumps?
2. What type of metal are sanitary pumps made of?
3. Why is it important not to have air pockets when using the centrifugal pump?
4. What is the one disadvantage of the gear pump?
5. Diagram the positions of the lobe or impeller sanitary pump.
6. Why is temperature of the product an important factor where rubber rotor pumps are used?
7. In what direction does the flexible impeller pum[illegible]erate?
8. Why is it necessary to clean the sanitary pumps daily?
9. Why should pumps not be damaged during cleaning?
10. How should O-Rings be lubricated?

Topic Test
on
RECEIVING EQUIPMENT

Student:______________________________ School:______________________________

Date:______________________________ Score:______________________________

Multiple Choice:

_______ 1. Most people favor the (a) drive-through, (b) back-up type of handling of tank trucks.

_______ 2. Most people favor the (a) one-weight tank, (b) two-weight tank system for continuous receiving of milk.

_______ 3. Most plants favor the (a) bulk handling, (b) can handling of milk.

_______ 4. Sampling of bulk milk is done on the (a) receiving deck, (b) farm.

_______ 5. Ventilation is (a) needed, (b) not needed in the receiving room.

Topic Test
on
MILK TANKS

Student:________________________ School:________________________

Date:________________________ Score:________________________

Write True beside the statements that are true and False beside the statements that are false.

______ 1. The two basic types of bulk storage tanks are horizontal and "silo."

______ 2. Fittings need not have smooth inner surfaces for cleaning because stainless steel will not rust.

______ 3. Most tanks are not insulated because they have cooling coils in the inner wall.

______ 4. It is not necessary to provide manholes in mechanically cleaned tanks.

______ 5. Where manholes are located any contents that may collect should drain to the outside of the tank.

______ 6. Milk storage tanks generally have thermometers to indicate the temperature of the product.

______ 7. It is desirable to have a level indication gauge on the tank to keep from overfilling the tank.

______ 8. Load cells are weight sensing elements used to determine the amount of product in the tank.

______ 9. Agitation of storage milk is not important because the milk is not sampled in the storage tanks.

______ 10. "Silo" type storage tanks are not constructed under the protection of a building.

Milk Tanks
(Topic Test continued)

_______11. "Silo" type storage tanks are agitated by air or mechanical means.

_______12. "Silo" type storage tanks must be vented with filtered air.

_______13. Expansion of the inner walls of large storage tanks should be of concern when constructing the tank.

Topic Test
on
FILTERS AND CLARIFIERS

Student:____________________ School:____________________

Date:____________________ Score:____________________

Multiple Choice:

______ 1. Milk should always be filtered (a) before, (b) after pasteurization.

______ 2. There (a) should, (b) should not be a large ratio of cloth area to milk flow.

______ 3. Leucocytes (a) can, (b) can not be removed by filters.

______ 4. Pressure on filter lines should not exceed (a) 4, (b) 6, (c) 8, (d) 10 pounds of pressure.

______ 5. Clarifiers remove (a) heavy, (b) light materials from milk.

______ 6. Clarifiers (a) do, (b) do not remove leucocytes and other types of cells from milk.

______ 7. The self-cleaning clarifiers (a) can, (b) can not be cleaned in place.

Topic Test
on
SEPARATORS AND HOMOGENIZERS

Student: ______________________ School: ______________________

Date: ______________________ Score: ______________________

Answer the following questions:

1. Warm milk separators operate at what temperature?
2. What percent fat should the Mojonnier test result in for proper skimming?
3. Can the self-cleaning separator be cleaned in place at the end of the separation process?
4. What is the capacity per hour of the cold milk separator?
5. To what temperature should cold milk be heated for best results?
6. What is the capacity of the standardizing clarifier?
7. What are the major purposes of the standardizing clarifiers?
8. How many processes can the Tri-Process centrifugals carry on at one time?
9. What is the accomplishment of the homogenization procedure?
10. What is the diameter size of fat globules after homogenization takes place?
11. What generally causes a "wild" gauge on the homogenizer?

Topic Test
on
HEATING, HOLDING, & COOLING EQUIPMENT

Student:____________________ School:____________________

Date:____________________ Score:____________________

Answer the following questions:

1. What is the purpose of heat exchange equipment in the milk plant?
2. What is the reason why copper or aluminum is not used in the flow coils of heat exchangers?
3. What do the letters HTST represent?
4. What is the holding time of the product at proper temperature of 161^{O}F. in the HTST pasteurizer?
5. What do the letters UHT represent?

Topic Test
on
SANITARY THERMOMETERS AND GAUGES

Student:______________________ School:______________________

Date:______________________ Score:______________________

Write True beside the statements that are true and False beside the statements that are false.

_______ 1. The reason for using instruments and gauges in the milk plant is for extension of human sensing.

_______ 2. Recorders provide a 24-hour record of from one to four variables in recording physical properties of the product.

_______ 3. The on-off differential gap control provides two decisions.

_______ 4. Temperature sensing devices provide the operator with an accurate means of measuring the temperature of the product.

_______ 5. Gauges are used to provide safety protection and temperature readings.

_______ 6. Gauges are calibrated by dead weight testers.

_______ 7. Weighing of the product is usually done on the farm by "dipstick" readings and weighing of the tank trucks at the milk plant.

_______ 8. Manometers are used to determine the level of solids in batch tanks.

_______ 9. Manometers work on the U-tube principle.

_______10. Many kinds of scales are used in the dairy plant to provide accurate weights of the product.

_______11. Flow measurements can be accurate to 0.25% in some metering devices.

_______12. Automat sanitary valves permit remote automatic control of product routing.

Topic Test
on
AUTOMATIC CONTROLS

Student:______________________ School:______________________

Date:______________________ Score:______________________

Write True beside the statements that are true and False beside the statements that are false.

_______ 1. The two general types of automatic temperature controls are self-acting and compressed air.

_______ 2. Self-acting type automatic temperature valves work on the volatile liquid principle.

_______ 3. Daily check maintenance for automatic controls is very important.

_______ 4. The air operated control valves are very accurate and generally trouble-free.

_______ 5. Air operated controls work on the vacuum line principle.

Topic Test
on
FILLERS AND SEALERS

Student:____________________ School:____________________

Date:____________________ Score:____________________

Fill in the blanks:

1. The two types of glass bottle fillers are ____________________ and ____________________.
2. Paper and glass milk containers range in size from________________ to ____________________.
3. The advantage of the vacuum filler is that it "pulls" the milk into the bottle for a ____________________ filling operation.
4. Paper containers are lined with __________ or ____________.
5. Paper containers require special handling to avoid cracks in the container which will allow ____________________.
6. Once filled, paper containers must be kept________________.
7. All-plastic containers are of two basic divisions, the ______________ and __________________.
8. On the vacuum filler the vacuum must be ____________________ to fill plastic containers.
9. Bulk, single-service containers are used both ____________________ and ____________________.
10. Bulk, single-service containers come lined with a ________________ bag.

Topic Test
on
CONVEYORS

Student:____________________ School:____________________

Date:____________________ Score:____________________

Write True beside the statements that are true and False beside the statements that are false.

______ 1. Gravity conveyors are no longer used in modern milk plants.

______ 2. Gravity conveyors need to be lubricated frequently with water repellent grease.

______ 3. Gravity conveyors are used to move bottles, dumping cans, and paper cartons.

______ 4. A conveyor system should be simple, direct, flexible, and free of trouble spots.

______ 5. Power conveyors are used to provide proper timing to coordinate the plant.

______ 6. Power conveyors should never be lubricated to avoid the build-up of dirt around moving parts.

______ 7. Power conveyors use pins, ball, slat, and chain type means of movement for the product.

______ 8. The drag-stack system is where drag chains are embedded in the floor to convey products.

______ 9. A palletized system involves the movement of stacks of products on a pallet which is moved by a lift truck.

______10. The marshalling of a product means the accumulation of it in stacks.

Topic Test
on
RECEIVING, FILTERING, AND CLARIFYING MILK

Student:__________________________ School:__________________________

Date:__________________________ Score:__________________________

Write True beside the statements that are true and False beside the statements that are false.

______ 1. All milk is received from the farm by bulk tank trucks.

______ 2. The temperature of milk should be kept under 32°F. during transportation and storage.

______ 3. When bulk milk is received, it is pumped into a bulk receiving tank and weighed.

______ 4. When milk is received in cans, the milk is put in a holding vat and the cans must be washed before returning them to the farmer.

______ 5. When canned milk is received, it is a good practice to check each can for quality of milk.

______ 6. All milk must be filtered or clarified before it is pasteurized.

______ 7. Clarification will remove leucocytes (body cells) from the milk which will cause sludge in homogenized milk.

______ 8. Filters are made of cloth and are placed in pipe lines carrying milk to filter the dirt and sediment from the milk.

______ 9. Milk should be pumped at 30 psi for best filtering.

Topic Test
on
COMMON PASTEURIZATION METHODS

Student;_______________ School:_______________

Date:_______________ Score:_______________

Multiple Choice:

_______ 1. Pasteurization destroys all yeasts and mold and (a) 80%, (b) 90%, (c) 95% of all bacteria in the milk.

_______ 2. Sterilization destroys (a) 90%, (b) 95%, (c) 100% of all living organisms in milk.

_______ 3. Batch pasteurization requires a temperature of 140°F. for (a) 30 seconds, (b) 30 minutes, (c) 30 hours.

_______ 4. In the HTST method of pasteurization, the temperature requirement is 161°F. for (a) 15 seconds, (b) 15 minutes, (c) 15 hours.

_______ 5. In the UHT method of pasteurization, the temperature requirement is 265° to 285°F. for (a) 3-8 seconds, (b) 3-8 minutes, (c) 3-8 hours.

Topic Test
on
OTHER METHODS OF PASTEURIZATION

Student:______________________ School:______________________

Date:______________________ Score:______________________

Write True beside the statements that are true and False beside the statements that are false.

_______ 1. Aseptic canning of milk allows the product to be stored without refrigeration.

_______ 2. Aseptic canned milk is not sterilized.

_______ 3. Sterilized milk may contain live yeast and molds.

_______ 4. Sterilized milk can be produced in paper containers.

_______ 5. Radiation is a means of pasteurization of milk.

_______ 6. Irradiated milk products turn in color.

_______ 7. Irradiated milk will jell in storage.

_______ 8. Ultraviolet light will pasteurize milk.

_______ 9. Pasteurization by ultraviolet light is a fast process.

_______ 10. Hydrogen peroxide acts as a preservative of milk and is used in many European countries.

_______ 11. Germany used hydrogen peroxide to preserve milk during WW II.

_______ 12. Hydrogen peroxide treated milk may be used in the U.S. in the manufacturing of cheese.

_______ 13. There has not been any success at pasteurizing milk by use of electric current.

_______ 14. England pasteurizes some of its milk in the bottle.

_______ 15. Pasteurization of milk in-the-bottle is not a costly process.

Topic Test
on
HOMOGENIZATION OF MILK

Student:______________________ School:______________________

Date:______________________ Score:______________________

Fill in the blanks:

1. Homogenized milk is defined as milk in which the fat globlues are not larger than ____________ microns in size.

2. In the homogenizer, milk is forced through small openings under ________ pounds of pressure per square inch.

3. Fat globules will not ____________ to the top in homogenized milk.

4. Milk should be homogenized after the ________________ process.

5. Milk should be homogenized at a temperature above ________ °F.

6. Homogenization of raw milk will cause the milk to become __________ very fast.

7. ________________ will remove most of the sediment from homogenized milk.

Topic Test
on
FILLING CONTAINERS

Student:______________________ School:______________________

Date:______________________ Score:______________________

Write True beside that statements that are true and False beside the statements that are false.

_______ 1. Milk containers are made of glass, paper, or plastic.

_______ 2. Gravity-flow fillers are used to fill paper containers.

_______ 3. Vacuum fillers cannot be used to fill all-plastic containers.

_______ 4. All bottles must be sterilized before filling.

_______ 5. Paper containers are lined with plastic or paraffin to keep milk from leaking out of the paper container.

_______ 6. There are non-returnable plastic bottles used for milk.

_______ 7. Paper cartons must be handled carefully to avoid damage to the carton.

_______ 8. Bulk single-service containers come in 2, 3, 5, and 6 gallon sizes.

_______ 9. Bulk single-service containers are reusable.

_______10. Paper containers are heat sealed by the filling machine.

Topic Test
on
MILK STORAGE

Student: ______________________________ School: ______________________________

Date: ______________________________ Score: ______________________________

Answer the following questions:

1. Why is rapid cooling after pasteurization important?
2. Why is warm milk not cooled in vat agitated by paddle or coils?
3. What is the usual method of cooling pasteurized milk?
4. When milk is refrigerated what is the general length in days of its keeping quality?
5. What causes the spoilage of milk after pasteurization?

Topic Test
on
CULTURES-FERMENTED MILK PRODUCTS

Student:____________________ School:____________________

Date:____________________ Score:____________________

Write True beside the statements that are true and False beside the statements that are false.

_______ 1. Cottage cheese is a cultured product.

_______ 2. Cultured milk products are high in butterfat.

_______ 3. Cultured products have a sour flavor caused by lactic acid produced by the bacteria culture.

_______ 4. Some cultural products have as high as 3% alcohol produced by yeasts.

_______ 5. It is very important to keep the culture free of foreign bacteria.

_______ 6. Starter cultures may be kept and used over and over for weeks if kept clean.

_______ 7. Bacteriophage destroy the culture bacteria causing slow or dead starters.

_______ 8. It is a good practice to have three people make cultures so if one person has to leave the other two can keep the culture clean.

_______ 9. Antibiotics used by the farmer may get into milk making the milk a poor culture product.

_______10. Yogurt is not a milk cultured product.

Topic Test
on
SKIM AND BUTTERMILK

Student:______________________________ School:______________________________

Date:______________________________ Score:______________________________

Write True beside the statements that are true and False beside the statements that are false.

_______ 1. Buttermilk may or may not be cultured.

_______ 2. Buttermilk is the liquid that remains after the removal of fat from the cream by churning.

_______ 3. Buttermilk is easily digested and is often recommended by doctors.

_______ 4. Buttermilk does not have the protein value of whole milk.

_______ 5. Churned buttermilk may have flakes of butter present.

_______ 6. Skim milk is very low in food value.

_______ 7. Skim milk is used to manufacture cottage cheese.

_______ 8. Condensed skim milk is about 1/3 its original volume.

_______ 9. Non-fat dry milk is made from skim milk.

Topic Test
on
SPECIAL MILKS AND DRINKS

Student:______________________________ School:______________________________

Date:______________________________ Score:______________________________

Write True beside the statements that are true and False beside the statements that are false.

_______ 1. Fortified milks include "vitamin D" milk.

_______ 2. Skim milk can be fortified and sold as fortified skim milk.

_______ 3. Soft-curd milk is more readily digested than whole milk.

_______ 4. Soft-curd milk can be made by addition of salts to milk.

_______ 5. Chocolate milk is not required to meet the minimum butterfat requirement.

_______ 6. Chocolate milk should be free of sediment.

_______ 7. Fresh concentrated milk has lacked large public sales.

_______ 8. Frozen milk provides a way to store fresh milk for longer periods of time.

_______ 9. Human milk is higher in protein than cows milk.

_______10. Human milk is more readily assimilated by the infant than cow's milk.

Topic Test
on
CREAM

Student;______________________ School:______________________

Date:______________________ Score:______________________

Multiple Choice:

_______ 1. The cream rises to the top of milk because it is (a) more dense, (b) thicker, (c) lighter, (d) thinner than milk solids.

_______ 2. Cream is separated from milk by a cream (a) pasteurizer, (b) separator, (c) bactofuge, (d) evaporator.

_______ 3. The cream bowl travels at the rate of (a) 300, (b) 3,000, (c) 30,000, (d) 300,000 r.p.m.

_______ 4. Cream goes to the (a) inside, (b) outside of the bowl during the separation process.

_______ 5. Cream separated at 50°F. has a better (a) keeping quality, (b) cream-line, (c) homogenizing quality, (d) viscosity than cream separated at 90°F.

Topic Test
on
CONCENTRATED MILK PRODUCTS

Student:________________________ School:________________________

Date:________________________ Score:________________________

Write True beside the statements that are true and False beside the statements that are false.

_______ 1. Fresh concentrated milk is reduced by one-half its volume.

_______ 2. Fresh concentrated milk is made from grade "B" milk.

_______ 3. The fat content of fresh concentrated milk is 10%.

_______ 4. Water is simply evaporated from milk to produce fresh concentrated milk.

_______ 5. Evaporated milk has had about 60% of the water removed.

_______ 6. Evaporated milk is not sterilized.

_______ 7. Evaporated milk can be stored only 1 year.

_______ 8. Evaporated milk is homogenized.

_______ 9. Evaporated milk can be stored at room temperature.

_______ 10. Sugar acts as the preservative in sweetened condensed milk.

Topic Test
on
ICE CREAM AND RELATED PRODUCTS

Student:____________________ School:____________________

Date:____________________ Score:____________________

Fill in the blanks:

1. Surveys indicate ____________ is the favorite American food.
2. The combination of ice cream ingredients is known as the "__________."
3. ________________ gives ice cream the rich flavor.
4. __________ and _______________ are important steps in the manufacturing of ice cream.
5. Ice cream is frozen to ______ ^{o}F.
6. The process of whipping air into the ice cream is known as __________.
7. Stabilizers are used to form a ____ which improves the body of the product.
8. Shrinkage involves the loss of _______ for the ice cream.

Topic Test
on
DRY MILK PRODUCTS

Student:________________________ School:________________________

Date:________________________ Score:________________________

Multiple Choice:

______ 1. The first successful dry milk product was (a) buttermilk, (b) skim milk, (c) cream, (d) malted milk.

______ 2. The drum rolling method of drying milk is done under (a) pressure, (b) vacuum, (c) gas, (d) heated air.

______ 3. The drum method of drying milk will produce (a) sheets, (b) crystals, (c) hollow spheres, (d) balls of dry milk.

______ 4. The spray drying method will produce (a) sheet, (b) crystals (c) hollow spheres, (d) balls of dry milk.

______ 5. In the spray method of drying milk, the milk is sprayed in a fine stream into (a) cold air, (b) hot air, (c) steam, (d) a vacuum, to remove the water.

______ 6. Dry whole milk has (a) an unlimited, (b) a limited, (c) a short, (d) a poor keeping quality.

______ 7. Dry whole milk is used mainly in the (a) baking industry, (b) home, (c) export business, (d) candy industry.

______ 8. 18% cream will produce dry cream of (a) 7%, (b) 27%, (c) 57%, (d) 72% butterfat.

______ 9. Non-fat dry milk is made from (a) whole milk, (b) whey, (c) malt, (d) skim milk.

______10. Dry whey is a valuable component in the manufacturing of (a) paint, (b) cosmetics, (c) poultry feed, (d) cheese.

Topic Test
on
BUTTER AND MARGARINE

Student:______________________ School:______________________

Date:______________________ Score:______________________

Write True beside the statements that are true and False beside the statements that are false.

_______ 1. Margarine is fortified with vitamin A and D to give it a yellow color.

_______ 2. Margarine has about the same amount of calories as butter.

_______ 3. Margarine contains some milk content.

_______ 4. Butter should be stored at 40°F.

_______ 5. Surface taint of butter is caused by bacterial contamination of butter.

_______ 6. Mottling and streaking due to insufficient working is a color defect of butter.

_______ 7. There are only two grades of butter, U.S.A. and U.S.B.

_______ 8. Butter is manufactured in butter products of whey butter, whipped butter, butter oil, and dry milk fat.

_______ 9. Overrun is caused by shipping air into the butter.

_______10. Butter cannot be processed in a continuous operation.

Topic Test
on
CHEESES

Student:____________________ School:____________________

Date:____________________ Score:____________________

Write True beside the statements that are true and False beside the statements that are false.

______ 1. The story of the first cheese made is lost in unrecorded history.

______ 2. There are 18 different ways to process cheese.

______ 3. Some kinds of hard cheese may require two years to ripen properly.

______ 4. Cheese is manufactured from skim milk.

______ 5. All milk in cheese is pasteurized.

______ 6. Ripening of milk is brought about with a bacterial starter.

______ 7. Rennin is used to curdle the ripened milk.

______ 8. Rennet is the commercial extract from rennin.

______ 9. Rennet will cause the vat of ripened milk to "set."

______10. The method of removal of whey will determine the kind of cheese being produced.

______11. All cheese rinds are allowed to grow molds for the ripening process.

______12. Salt is added to cheese as a preservative only.

______13. Enzymes, bacteria, molds, and yeasts bring about the ripening of cheese.

Topic Test
on
CHEDDAR AND COTTAGE CHEESE

Student:____________________ School:____________________

Date:____________________ Score:____________________

Fill in the blanks:

1. _________ was the first kind of cheese manufactured for commercial use.
2. Milk is heated to ______ ^{o}F. for good growth of the starter organisms.
3. _________ is added to coagulate the acid-formed milk in making cheddar cheese.
4. After the curd has "set" it is cut into small ____________ in making cheddar cheese.
5. The __________ should be drained from the curd.
6. The curds are pressed for 12 to 24 hours to remove excess __________.
7. Cheddar cheese should be cured for ______ to _____ months.

Topic Test
on
PROCESS AND SWISS CHEESE

Student:____________________ School:____________________

Date:____________________ Score:____________________

Write True beside the statements that are true and False beside the statements that are false.

_______ 1. Process cheeses are made by mixing and grinding together different lots of cheese.

_______ 2. Cheddar is the most commonly processed variety of cheese.

_______ 3. Processed cheeses must be heated to 150°F. for 30 seconds.

_______ 4. Emulsifying agents cause processed cheeses to be lumpy.

_______ 5. All process cheese food will have other foods added to the cheese.

_______ 6. Processed cheese spread is 40% to 60% water.

_______ 7. There are no sweetening agents added to process cheese spreads.

_______ 8. Milk is pasteurized before Swiss Cheese can be made from the milk.

_______ 9. Swiss Cheese is made in copper kettles.

_______10. Gas is added to the cheese with a high pressure gas hose to make the "eyes" in Swiss Cheese.

_______11. Swiss Cheese needs to ripen about 6 months.

_______12. A good Swiss Cheese will have holes 1/2 to 1 1/2" in diameter.

_______13. Swiss Cheese will keep only 6 months.

Topic Test
on
OTHER VARIETIES OF CHEESE

Student:______________________ School:______________________

Date:______________________ Score:______________________

Write True beside the statements that are true and False beside the statements that are false.

_______ 1. Brick Cheese is not rubbed with salt.

_______ 2. Brick Cheese is perishable and must be refrigerated.

_______ 3. Caciocarrallo Cheese is pulled into long rope-like pieces and dried in a figure-8.

_______ 4. Coon Cheese has a sharp, tangy flavor and a crumbly body.

_______ 5. Cream Cheese is a soft unripened cheese made of milk and cream.

_______ 6. Edam Cheese is not allowed to form acid and is not salted.

_______ 7. Feta Cheese is made from ewe's milk.

_______ 8. Limburger Cheese has a sweet milk flavor.

_______ 9. Pickled Cheese is ripened in a brine solution.

_______ 10. Roquefort Cheese has a marble blue-green appearance.

Topic Test
on
USES OF STEAM AND HOT WATER

Student:______________________________ School:______________________________

Date:______________________________ Score:______________________________

Fill in the blanks:

1. Steam is used for ______________, ______________________________ and ______________________________.

2. ________ to ________ pounds of steam are required to pasteurize 1,000 pounds of milk by the batch process.

3. The letters Btu mean ____________________ _______________ ____________.

4. One Btu will raise the temperature of 1/2 pound of water ____________ °F.

5. Fifty Btu will raise the temperature of one pound of water ____________ °F.

Topic Test
on
HOT WATER REQUIREMENTS

Student:____________________ School:____________________

Date:____________________ Score:____________________

Multiple Choice:

______ 1. Steam is used in most plants for (a) power, (b) washing, (c) steam driven pumps, (c) heating cheese.

______ 2. Hot water is usually made by (a) direct-fire hot generators, (b) steam coils in a tank, (c) condensed steam, (c) electrically heated tanks.

______ 3. Showers use (a) 100, (b) 150, (c) 225, (c) 300 gallons per hour.

______ 4. The largest hot water requirement will be during (a) noon, (b) morning, (c) beginning of day, (d) clean up.

______ 5. Hot water should be (a) 140^{O}F., (b) 110^{O}F., (c) 100^{O}F., (d) 200^{O}F. for washing rooms.

Topic Test
on
BOILERS

Student:______________________ School:______________________

Date:______________________ Score:______________________

Write True beside the statements that are true and False beside the statements that are false.

_______ 1. There are five classes of boilers.

_______ 2. Fire-tube boilers are the most efficient type of boiler.

_______ 3. Boiler tubes are made of stainless steel.

_______ 4. Clean heating surfaces reduces the cost of heating.

_______ 5. Boilers should not be filled while hot.

_______ 6. Boilers should be filled with hot water if available.

_______ 7. It is not necessary to ventilate the heater before lighting.

_______ 8. Safety valves should be hand opened to be sure they will operate.

_______ 9. A plant "log" should be kept of cleaning operations.

_______ 10. "Do Not Open" signs should be used to prevent the scalding of workers.

Topic Test
on
WATER SOURCES AND CONSERVATION

Student:____________________ School:____________________

Date:____________________ Score:____________________

Write True beside the statements that are true and False beside the statements that are false.

______ 1. Soft, cold, clean water is ideal for a milk plant.

______ 2. Cities that use surface water will supply a water high in minerals and trash.

______ 3. All well water will be "soft."

______ 4. City water is too costly to use in the milk plant.

______ 5. The milk plant should adopt a definite water conservation program.

______ 6. The milk plant should have studies made to locate ways of saving water.

______ 7. Whenever possible it is best to return condensation and overflow water to the boilers for reuse.

Topic Test
on
WATER IMPURITIES

Student:________________________ School:________________________

Date:________________________ Score:________________________

Write True beside the statements that are true and False beside the statements that are false.

_______ 1. It is not necessary to analyze water for use in the milk plant.

_______ 2. Hard water is caused by dissolved metal salts in the water.

_______ 3. Water that has dissolved gases in it may be harmful and corrosive.

_______ 4. Sulfides give water a sweet flavor.

_______ 5. Sulfides tend to discolor the water.

_______ 6. A slightly acid water is best for washing cottage cheese curds.

_______ 7. Dissolved solids can be removed from water by deionization which is an expensive operation.

_______ 8. Rotting vegetation will discolor water.

Topic Test
on
FILTERS, CHLORINATION, AND CORROSION

Student:______________________ School:______________________

Date:______________________ Score:______________________

Fill in the blanks:

1. Typical water filters will contain several grades of __________ and ________.
2. The ______________ bed should be at least 20 inches thick.
3. The filter should be back washed to prevent "________________."
4. Activated ______________ is used to remove odor from water.
5. The "_____________" filter will remove all traces of suspended matter.
6. All the maintenance required of the water filter is repair of _____________ and periodic ___________________.
7. The __________ needs to be charged when "mud balls" form.
8. ____________________ gas is used for disinfection of water.
9. Corrosion may be controlled by removal of dissolved ________________ and __________________.
10. One of the best ways of preventing corrosion is by a _________________ coating of paint.

Topic Test
on
CORRECTIVE WATER TREATMENTS

Student:________________________ School:________________________

Date:________________________ Score:________________________

Write True beside the statements that are true and False beside the statements that are false.

______ 1. Cooling water should not be allowed to deposit hardness scale on piping or equipment.

______ 2. Water softening equipment will pay for itself by increasing the life of the plant equipment.

______ 3. Lime-soda treatment accuracy is hard to control to maintain a uniform softened water.

______ 4. Lime-soda treatment of water will reduce the sediment of water.

______ 5. Lime-soda treated water need not be filtered for removal of sediment.

______ 6. Zeolite is the product used in the base exchange method of softening water.

______ 7. The zeolite bed should be 30 to 72 inches thick.

______ 8. Zeolite can be cleaned with a sugar solution.

______ 9. Zeolite can remove all minerals and produce a zero hardness water.

______10. In most plants the zeolite softener will do the most efficient job.

Topic Test
on
PUMPS AND PIPING

Student:______________________ **School:**______________________

Date:______________________ **Score:**______________________

Fill in the proper letter:

(a) Centrifugal pump (b) Rotary pump (c) Reciprocating pump

_______ 1. Which pump operates with a piston?

_______ 2. Which pump will handle dirty liquids best?

_______ 3. Which pump uses the impeller?

_______ 4. Which pump uses the gear principle of operation?

_______ 5. Which pump will develop the highest pressure?

_______ 6. Which pump will carry the largest volume?

_______ 7. Which pump handles medium pressure ranges best?

_______ 8. Which pump has a pulsating flow?

Topic Test
on
AIR COMPRESSORS

Stu ______________________ School: ______________________

Date: ______________________ Score: ______________________

Write True beside the statements that are true and False beside the statements that are false.

_______ 1. The air compressor is not an important item of equipment in the milk plant.

_______ 2. Oil-free compressors are used when in contact with the product.

_______ 3. Multi-stage compressors usually cool the air between stages.

_______ 4. Air compressors should operate between 400 and 500 psi.

_______ 5. A wide operating range reduces the number of starts needed to be made during the day.

_______ 6. The multi-stage compressor is most desirable for low pressure usage.

_______ 7. Air receivers should be large enough to avoid abrupt pressure drops.

_______ 8. Aftercoolers need to be placed close to the compressor for best results.

Topic Test
on
TERMINOLOGY AND REQUIREMENTS

Student:______________________ School:______________________

Date:______________________ Score:______________________

PART I: Match the following:

_______	1.	Maximum electrical current requirement	a.	Phase
_______	2.	Equals 1000 watts	b.	Ohm
_______	3.	kwh	c.	Kilowatt hour
_______	4.	Amount of current	d.	Kilowatt
_______	5.	Unit of resistance to current	e.	Demand
_______	6.	Type of alternating current	f.	Ampere

PART II: Match the following:

_______	1.	Absolute pressure after and before compression	a.	Convection
_______	2.	Measure of heat	b.	Latent heat
_______	3.	Movement of heat by gas or liquid	c.	Compression ratio
_______	4.	Instantaneous evaporation of refrigerant	d.	Ton of refrigeration
_______	5.	When water changes to steam	e.	Flash gas
_______	6.	Extract 288,000 Btu in 24 hours	f.	Btu

Topic Test
on
WIRING MATERIALS AND CONTROLS

Student:______________________ School:______________________

Date:______________________ Score:______________________

Write True beside the statements that are true and False beside the statements that are false.

______ 1. It is not important to ground electrical motors.

______ 2. General lighting circuits should have a minimum of four (4) outlets per circuit.

______ 3. When grounding conductor to a panel, at least No. 6 copper wire should be used.

______ 4. The size of wire is not important in wiring a building.

______ 5. Wire insulation is not important in wiring a building.

______ 6. Voltage drop is not affected by wire size.

______ 7. Safety is stopping accidents before they take place.

______ 8. Fuses are used for protection of the electrical circuit.

______ 9. Each circuit should be fused separately.

______10. A.V.C. wire is needed when temperatures are over 125°F.

Topic Test
on
ELECTRIC MOTORS

Student:______________________ School:______________________

Date:______________________ Score:______________________

Write True beside the statements that are true and False beside the statements that are false.

_______ 1. Splash-proof motors are desirable in the milk plant.

_______ 2. All small motors should run at 1800 rpm to reduce the number of spare motors needed.

_______ 3. All large motors should have magnetic starters.

_______ 4. It is not necessary to provide overload protection on large motors.

_______ 5. Three phase motors should always be used whenever possible.

Topic Test
on
"SWEET WATER" AND BRINE REFRIGERATION SYSTEMS

Student:____________________ School:____________________

Date:____________________ Score:____________________

Fill in the blanks:

1. The "Sweet Water" cooling system should not operate under __________ °F.

2. Refrigeration is needed to __________ the product in the milk plant.

3. Well water will have a temperature range of __________ °F. to __________ °F.

4. "Sweet Water" can be cooled by passing it through an ______ storage tank.

5. Brine cooling systems can be cooled below the __________ point of water.

6. Salt Brine cooling systems can be cooled below __________ °F.

Topic Test
on
MECHANICAL REFRIGERATION SYSTEMS

Student:____________________ School:____________________

Date:____________________ Score:____________________

Write True beside the statements that are true and False beside the statements that are false.

______ 1. Refrigeration systems must have a compressor.

______ 2. Compressors should be protected with shut-off switches.

______ 3. The high pressure side of the system should never be modified.

______ 4. Ammonia is soluble in oil and losses in ammonia will result.

______ 5. Automatic liquid control valves will never leak.

______ 6. Warm, high pressure liquid will flash to a gas on the low preswure side.

______ 7. Low temperature refrigeration systems are used for making ice cream.

______ 8. In a compound system, it takes several stages to compress the refrigerant gas.

Topic Test
on
MAINTENANCE OF REFRIGERATION SYSTEMS

Student:_______________ School:_______________

Date:_______________ Score:_______________

Write True beside the statements that are true and False beside the statements that are false.

_______ 1. It is not important for plant personnel to know the characteristics of the refrigeration system.

_______ 2. The cost of a ton of refrigeration is high when the compressor is not operating at full capacity.

_______ 3. Changes in group routines can affect the operating efficiency of the refrigeration system.

_______ 4. Operating logs are nice but not necessary.

_______ 5. Automatic controls need not be checked continually.

_______ 6. The maintenance of refrigeration equipment is the responsibility of the plant owner.

_______ 7. It is good to consult a refrigeration specialist to review operation procedures.

_______ 8. Schools are conducted to train personnel in proper refrigeration maintenance by equipment manufacturers.

Topic Test
on
PRODUCT LOSSES AND RECORDS

Student:______________________ School:______________________

Date:______________________ Score:______________________

Write True beside the statements that are true and False beside the statements that are false.

_______ 1. Crash programs to stop product losses will give only short period results.

_______ 2. The main interest in determining product losses is not in what is lost but the difference between what the plant buys and sells.

_______ 3. The butterfat is not salvaged from route return products.

_______ 4. It is not necessary to agitate milk before sampling.

_______ 5. Too much cream left in the milk during the separation process will result in losses to the plant efficiency.

_______ 6. Poor drainage of bulk tanks will result in losses to the plant efficiency.

_______ 7. Over-filling of bottles and paper containers will result in losses of product.

_______ 8. Lack of movement of the finished product will not result in losses because milk can be powdered.

_______ 9. Evaporation is so slight that it need not be considered as a loss.

_______10. Systematic allocation for employee use should be used to control losses.

Topic Test
on
OPERATING EFFICIENCIES AND PRODUCTION SCHEDULES

Student:_______________________ School:_______________________

Date:_______________________ Score:_______________________

Fill in the blanks:

1. Production cost can be high because someone did not stop to _________.
2. Remodeling or rebuilding can reduce production ________________.
3. Supervisors should be convinced that a high degree of _____________ is necessary.
4. Proper lighting, heating, ventilation, and air conditioning are important for good ____________________ conditions.
5. Automatic casers can increase the ______________ operation.
6. All electrical __________ should be located close to the equipment.
7. A simple work __________ system is of great value in cutting costs.
8. A ____________ valve at the end of the water hose will save on water costs.
9. Lights should be _____________ at night.
10. Storage rooms should be kept ______________ and clean.

Topic Test
on
CONTAINER LOSSES

Student:____________________ School:____________________

Date:____________________ Score:____________________

Write True beside the statements that are true and False beside the statements that are false.

_______ 1. "Stones" are flaws in new bottles.

_______ 2. All new bottles should be inspected.

_______ 3. Bottles should not be stored in dry conditions.

_______ 4. Bottle washing may cause etching and scratching of the bottle.

_______ 5. Capping causes a large percentage of breakage in the milk plant.

_______ 6. Transit breakage is low because the bottles are kept in cases.

_______ 7. Heat will not cause breakage to milk bottles.

_______ 8. Impact breakage will cause percussion cones on the bottles.

_______ 9. Stacking too high will warp made-up paper containers.

_______10. All paper containers should be kept cold during transit with wet ice.

Topic Test
on
WASTE PREVENTION

Student:____________________ School:____________________

Date:____________________ Score:____________________

Write True beside the statements that are true and False beside the statements that are false.

______ 1. Waste prevention will not save money for the dairy plant.

______ 2. Waste prevention is practiced only to comply with strict regulations.

______ 3. The biggest factor in waste prevention is the personal factor.

______ 4. Poor equipment will cause waste.

______ 5. It is a good practice to mark the directions "off" and "on" on all valves to avoid waste.

______ 6. Be sure to place the proper fitting on the proper way to avoid leakage.

______ 7. Do not boil products to cause evaporation losses.

______ 8. Separators do not need to be air tight.

______ 9. Milk loss is greater with tank-trucks than with cans.

______10. Dry products should be washed down the drain.

Topic Test
on
WASTE DISPOSAL

Student:____________________ School:____________________

Date:____________________ Score:____________________

Write True beside the statements that are true and False beside the statements that are false.

______ 1. The most important step in waste saving and waste disposal is complete utilization of the product.

______ 2. Milk waste should be used for livestock feed, evaporated, or dried.

______ 3. It is not important to measure or sample dairy plant wastes.

______ 4. You should always let the municipal sewer operator know when you plan to dump large quantities of waste.

______ 5. Dumping milk waste into streams is good fish food.

______ 6. Crops can be irrigated from milk plant wastes.

______ 7. A good place to dump waste is in a closed, company owned pond.

______ 8. Trickling filters will help remove solids from the waste.

______ 9. Anaerobic treatment of wastes in lagoons is a cheap method of treating wastes.

______10. Using chemicals to precipitate solids out of the waste is a good treatment method.

Topic Test
on
PAINTING

Student:____________________ School:____________________

Date:____________________ Score:____________________

Write True beside the statements that are true and False beside the statements that are false.

______ 1. Paint will protect the value of the equipment.

______ 2. Well-painted equipment will relate milk quality to the customer.

______ 3. Paints selected should be able to withstand acid.

______ 4. Everything should be painted white.

______ 5. Walls need not be dry when painting with oil based paints.

______ 6. Spray painting will provide the fastest method of painting.

______ 7. Vinyl based paints are not practical for milk plant use.

______ 8. Paints should be smooth and mold resistant.

Topic Test
on
FLOOR, ROOF, AND WALLS

Student:____________________ School:____________________

Date:____________________ Score:____________________

Write True beside the statements that are true and False beside the statements that are false.

______ 1. Concrete floors should be used where acid is likely to spill on the floor.

______ 2. Tile floors chip too easily to be used in the milk plant.

______ 3. Metal roofs are not practical in the milk plant.

______ 4. Wood floors should be used in the dock area for ease of handling cans.

______ 5. Wood walls are not usually practical in the milk plant.

______ 6. Asbestos-asphalt roof coating material will increase the life of the roof.

______ 7. Masonry wall cracks should be caulked once a year.

______ 8. Gasketed doors should be checked regularly for air leaks.

Topic Test
on
LIGHTING, VENTILATION, AND AIR CONDITIONING

Student:______________________ School:______________________

Date:______________________ Score:______________________

Write True beside the statements that are true and False beside the statements that are false.

_______ 1. Good lighting will reduce bottle breakage.

_______ 2. Good lighting will not affect the utilization of floor space.

_______ 3. The quantity of light is determined by daylight illumination, and color of the room.

_______ 4. Good lighting will not affect cleanliness of the plant.

_______ 5. Good lighting will result in fewer accidents.

_______ 6. Proper ventiliation will increase worker output.

_______ 7. Moisture cannot be controlled by the ventilating system.

_______ 8. Proper humidity will increase worker efficiency.

_______ 9. Heating of the plant is in the central venting and air conditioning system.

_______10. The entire milk plant should be air conditioned for best results.

Topic Test
on
LUBRICATION

Student:______________________ School:______________________

Date:______________________ Score:______________________

Indicate by each of the following Yes or No:

_______ 1. Can machinery operate successfully without proper lubrication?

_______ 2. The primary function of lubricants is to reduce friction.

_______ 3. Do all liquids possess the property of viscosity?

_______ 4. Graphite is a solid lubricant.

_______ 5. Greases will not prevent the entrance of dust and dirt.

_______ 6. Oils can be used on open-housed parts.

_______ 7. Sleeve bearings should be lubricated with graphite.

_______ 8. Do anti-friction bearings need lubrication?

_______ 9. Always use gasoline to clean chains and other parts before repacking with grease.

_______10. A lubrication schedule should be made and followed for best results.

Answer Sheet to Test
on
SCOPE, TRENDS, AND OPPORTUNITIES

1. True
2. True
3. True
4. False
5. False
6. False
7. True
8. False
9. False
10. True

961-I-2
Page 6

Answer Sheet to Test
on
JOB TRAINING AND ACCEPTANCE OF JOB SUPERVISION

1. All those aspects of the job necessary to its successful accomplishment
2. To provide him with an understanding of his job, the responsibilities of his job, and what the employer expects him to produce while on the job
3. To provide plant efficiency
4. To keep up with new developments and techniques in the processing of milk.

Answer Sheet to Test
on
PLANT LAYOUTS

1. True
2. False
3. True
4. True
5. True

Answer Sheet to Test
on
ACCIDENT PREVENTION AND FIRST AID

1. False
2. False
3. False
4. True
5. True
6. True
7. True
8. False
9. True
10. False

961-II-1
Page 7

Answer Sheet to Test
on
SECRETION, COMPOSITION, AND PROPERTIES OR MILK

1. Ture
2. True
3. True
4. False
5. True
6. False
7. True
8. True
9. False
10. True

961-II-2
Page 6

Answer Sheet to Test
on
MILK FAT

1. b
2. i
3. f
4. g
5. h
6. d
7. j
8. c
9. a
10. e

Answer Sheet to Test
on
MILK PROTEINS

1. Nitrogen
2. Amino acids
3. Casein
4. Acid or rennin
5. 95 to 100
6. Plastics
7. Paper
8. Lactalbumin and lactoglobulin
9. Rennin
10. Colostrum

Answer Sheet to Test
on
MILK SUGAR

1. False
2. False
3. True
4. False
5. False
6. False
7. True
8. False
9. False
10. False

Answer Sheet to Test
on
MINERALS AND WATER IN MILK

1. True
2. True
3. True
4. True
5. False
6. True
7. True
8. True
9. False
10. True

961-II-6
Page 6

Answer Sheet to Test
on
VITAMINS IN MILK

1. d
2. f
3. i
4. j
5. g
6. a
7. e
8. b
9. h
10. c

Answer Sheet to Test
on
MICROBIOLOGY OF DAIRY PRODUCTS

1. True
2. True
3. True
4. False
5. False
6. True
7. True
8. False
9. True
10. True

961-III-2
Page 6

Answer Sheet to Test
on
MILK AND DISEASES

1. d
2. f
3. h
4. b
5. g
6. a
7. i
8. j
9. e
10. c

Answer Sheet to Test
on
ANTIBIOTICS, PESTICIDES, AND RADIOACTIVITY

1. False
2. True
3. False
4. True
5. False
6. False
7. True
8. True
9. False

961-III-4
Page 4

Answer Sheet to Test
on
HOUSEKEEPING PRINCIPLES

1. True
2. True
3. False
4. False
5. False
6. False
7. False
8. False
9. True
10. False

Answer Sheet to Test
on
CLEANING AND CARING FOR EQUIPMENT

1. g
2. f
3. d
4. a
5. i
6. h
7. b
8. e
9. j
10. c

Answer Sheet to Test
on
SANITIZING DAIRY EQUIPMENT

1. True
2. True
3. False
4. False
5. False
6. True
7. False
8. True
9. False

Answer Sheet to Test
on
CANS AND CAN WASHING

1. False
2. False
3. True
4. False
5. False
6. True
7. True
8. True
9. False
10. False

Answer Sheet to Test
on
BOTTLE WASHING

1. h
2. e
3. i
4. a
5. f
6. c
7. j
8. g
9. b
10. d

Answer Sheet to Test
on
INSECT AND RODENT CONTROL

1. Management
2. "Mayhave"
3. Flies and roaches
4. Fine mesh screens
5. Insecticide spray
6. Entomology
7. Environment, insecticides
8. Rodent-proofed
9. Perimeter
10. Die

Answer Sheet to Test
on
GRADES AND CLASSES OF MILK

1. False
2. True
3. True
4. False
5. False
6. True
7. True
8. False

961-IV-2
Page 6

Answer Sheet to Test
on
FLAVOR AND PHYSICAL DEFECTS

PART I:

1. False
2. False
3. True
4. False
5. False

PART II:

1. c
2. e
3. d
4. a
5. b

961-IV-3
Page 4

Answer Sheet to Test
on
SAMPLING

PART I:

1. False
2. False
3. True
4. False
5. False

PART II:

1. Thoroughly mixed or agitated
2. Preservative
3. Dipper
4. Slowly
5. Smell

961-IV-4
Page 6

Answer Sheet to Test
on
BACTERIOLOGICAL TESTS

1. True
2. True
3. False
4. False
5. False
6. False
7. True
8. True
9. False
10. True

Answer Sheet to Test
on
BUTTERFAT TESTS

1. e
2. j
3. g
4. i
5. a
6. b
7. h
8. c
9. d
10. f

961-IV-6
Page 9

Answer Sheet to Test
on
SOLIDS-NOT-FAT TESTS

PART I:		PART II:	
1.	Hydrometer	1.	False
2.	60°	2.	False
3.	102°	3.	True
4.	50° to 70°	4.	True
5.	1.032	5.	True

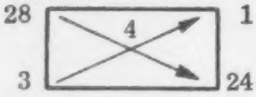
Answer Sheet to Test
on
ACIDITY TESTS

1. False
2. True
3. True
4. False
5. False
6. False
7. True
8. True
9. False
10. True

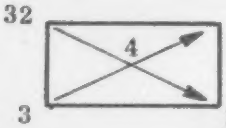
Answer Sheet to Test
on
MISCELLANEOUS TESTS

1. d
2. f
3. i
4. a
5. c
6. h
7. j
8. g
9. b
10. e

Answer Sheet to Test
on
STANDARDIZING DAIRY ARITHMETIC

1. Fat content
2. Pearson Square
3. Fat content
4. 

1 part cream to 24 parts milk

5. 

1 part cream
28 parts milk
29 total parts

1 : 29 :: X : 600
29X = 600
X = 20.69 lbs. of 32% cream

28 : 29 :: X : 600
29X = 16800
X = 579.31 lbs. of 3% milk

961-IV-10
Page 6

Answer Sheet to Test
on
GRADES OF CREAM

1. True
2. True
3. False
4. False
5. False
6. True
7. True
8. True
9. False
10. True

Answer Sheet to Test
on
EQUIPMENT LAYOUT

1. True
2. False
3. True
4. True
5. False
6. True
7. True
8. False
9. False
10. False

Answer Sheet to Test
on
MATERIALS FOR DAIRY EQUIPMENT

1. True
2. True
3. True
4. False
5. False
6. False
7. False
8. True
9. True
10. True

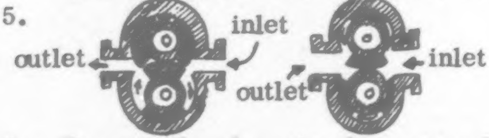
Answer Sheet to Test
on
SANITARY PIPE AND FITTINGS

1. True
2. True
3. False
4. False
5. False
6. False
7. True
8. True
9. True
10. True

961-V-4
Page 4

Answer Sheet to Test
on
SANITARY PUMPS

1. Splash proof motors
2. Stainless steel
3. The rapid action will whip the air into the product.
4. Quality damage to product due to excess pressures
5.



6. To provide adequate clearances for the rotor
7. Either (answer is on page 290, Manual for Milk Plant Operators)
8. To keep them sanitary
9. To avoid pump efficiency loss
10. Place a little cream, milk, or orange oil on inner surface of the seal.

Answer Sheet to Test
on
RECEIVING EQUIPMENT

1. a
2. b
3. a
4. b
5. a

961-V-6
Page 5

Answer Sheet to Test
on
MILK TANKS

1. True
2. False
3. False
4. False
5. True
6. True
7. True
8. True
9. False
10. True
11. True
12. True
13. True

Answer Sheet to Test
on
FILTERS AND CLARIFIERS

1. a
2. a
3. b
4. d
5. a
6. a
7. a

Answer Sheet to Test
on
SEPARATORS AND HOMOGENIZERS

1. 80 to 85°F.
2. .06 to .10% fat
3. yes
4. 10,000# per hour
5. 45° to 50°F.
6. 40,000# milk per hour
7. Standardize fat content and clarify milk
8. one
9. Breaking of fat globules into small particles
10. Less than 2 microns in diameter
11. Air in the line

Answer Sheet to Test
on
HEATING, HOLDING, & COOLING EQUIPMENT

1. Pasteurization and recooling of milk
2. Produces off-flavors, corrodes, and is not strong enough and too expensive
3. High-temperature short-time
4. 2,000 pounds per hour to 65,000 pounds per hour
5. 15 seconds
6. Ultra high temperature

Answer Sheet to Test
on
SANITARY THERMOMETERS AND GAUGES

1. True
2. True
3. True
4. True
5. False
6. True
7. False
8. False
9. True
10. True
11. True
12. True

Answer Sheet to Test
on
AUTOMATIC CONTROLS

1. True
2. True
3. True
4. True
5. False

Answer Sheet to Test
on
FILLERS AND SEALERS

1. Gravity-flow and vacuum
2. 1 gallon to 1/2 pint
3. Faster
4. Plastic or paraffin
5. Milk leakage
6. Cold
7. Returnable and non-returnable
8. Reduced
9. Commercially and in the home
10. Plastic

Answer Sheet to Test
on
CONVEYORS

1. False
2. True
3. False
4. True
5. True
6. False
7. True
8. True
9. True
10. True

Answer Sheet to Test
on
RECEIVING, FILTERING, AND CLARIFYING MILK

1. False
2. False
3. True
4. True
5. True
6. True
7. True
8. True
9. False

Answer Sheet to Test
on
COMMON PASTEURIZATION METHODS

1. c
2. c
3. b
4. a
5. a

Answer Sheet to Test
on
OTHER METHODS OF PASTEURIZATION

1. True
2. False
3. False
4. True
5. True
6. True
7. True
8. True
9. False
10. True
11. True
12. True
13. False
14. True
15. False

Answer Sheet to Test
on
HOMOGENIZATION OF MILK

1. 2
2. 2000 to 3000 psi
3. Rise
4. Pasteurization
5. 140° F.
6. Rancid
7. Clarification

Answer Sheet to Test
on
FILLING CONTAINERS

1. True
2. True
3. False
4. True
5. True
6. True
7. True
8. True
9. False
10. True

Answer Sheet to Test
on
MILK STORAGE

1. To prevent the growth of surviving bacteria
2. Agitation of warm milk favors separation of the fat globules.
3. With surface-type coolers
4. 5 to 6
5. Bacterial contamination

Answer Sheet to Test
on
CULTURES-FERMENTED MILK PRODUCTS

1. True
2. False
3. True
4. True
5. True
6. False
7. True
8. False
9. True
10. False

Answer Sheet to Test
on
SKIM AND BUTTERMILK

1. True
2. True
3. True
4. False
5. True
6. False
7. True
8. True
9. True

Answer Sheet to Test
on
SPECIAL MILKS AND DRINKS

1. False
2. True
3. True
4. True
5. False
6. True
7. True
8. True
9. False
10. True

Answer Sheet to Test
on
CREAM

1. c
2. b
3. b
4. a
5. d

Answer Sheet to Test
on
CONCENTRATED MILK PRODUCTS

1. False
2. False
3. True
4. True
5. True
6. False
7. False
8. True
9. True
10. True

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Answer Sheet to Test
on
ICE CREAM AND RELATED PRODUCTS

1. Ice cream
2. Mix
3. Butterfat
4. Pasteurization and homogenization
5. 21° to 24°F.
6. Overrun
7. Gel
8. Air

Answer Sheet to Test
on
DRY MILK PRODUCTS

1. d
2. b
3. a
4. c
5. b
6. b
7. a
8. c
9. d
10. c

Answer Sheet to Test
on
BUTTER AND MARGARINE

1. False
2. True
3. True
4. False
5. True
6. True
7. False
8. True
9. False
10. False

Answer Sheet to Test
on
CHEESES

1. True
2. True
3. True
4. False
5. False
6. True
7. True
8. True
9. True
10. True
11. False
12. False
13. True

Answer Sheet to Test
on
CHEDDAR AND COTTAGE CHEESE

1. Cheddar
2. 87
3. Rennet
4. Cubes
5. Whey
6. Moisture
7. 3 to 12

Answer Sheet to Test
on
PROCESS AND SWISS CHEESE

1. True
2. True
3. True
4. False
5. True
6. True
7. False
8. False
9. True
10. False
11. True
12. True
13. False

Answer Sheet to Test
on
OTHER VARIETIES OF CHEESE

1. False
2. True
3. True
4. True
5. True
6. False
7. True
8. False
9. True
10. True

Answer Sheet to Test
on
USES OF STEAM AND HOT WATER

1. Processing, cleaning, sanitizing
2. 140 to 220
3. British thermal unit
4. Two
5. 50^{o}F.

Answer Sheet to Test
on
HOT WATER REQUIREMENTS

1. b
2. b
3. c
4. d
5. a

Answer Sheet to Test
on
BOILERS

1. False
2 False
3. False
4. True
5. True
6. True
7. False
8. True
9. True
10. True

Answer Sheet to Test
on
WATER SOURCES AND CONSERVATION

1. True
2. False
3. False
4. False
5. True
6. True
7. True

Answer Sheet to Test
on
WATER IMPURITIES

1. False
2. True
3. True
4. False
5. True
6. True
7. True
8. True

Answer Sheet to Test
on
FILTERS, CHLORINATION, AND CORROSION

1. Gravel and sand
2. Sand
3. Fouling
4. Carbon
5. Polishing
6. Leaks, painting
7. Sand
8. Chlorine
9. Gases and minerals
10. Protective

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Answer Sheet to Test
on
CORRECTIVE WATER TREATMENTS

1. True
2. True
3. True
4. False
5. False
6. True
7. True
8. False
9. True
10. True

Answer Sheet to Test
on
PUMPS AND PIPING

1. c
2. a
3. a
4. b
5. c
6. a
7. b
8. c

Answer Sheet to Test
on
AIR COMPRESSORS

1. False
2. True
3. True
4. False
5. True
6. False
7. True
8. True

Answer Sheet to Test
on
TERMINOLOGY AND REQUIREMENTS

	PART I:		PART II:
1.	e	1.	c
2.	d	2.	f
3.	c	3.	a
4.	f	4.	e
5.	b	5.	b
6.	a	6.	d

Answer Sheet to Test
on
WIRING MATERIALS AND CONTROLS

1. False
2. False
3. True
4. False
5. False
6. False
7. True
8. True
9. True
10. True

Answer Sheet to Test
on
ELECTRIC MOTORS

1. True
2. True
3. True
4. True
5. True

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Answer Sheet to Test
on
"SWEET WATER" AND BRINE REFIRGERATION SYSTEMS

1. 38°F.
2. Cool
3. 55° to 65°F.
4. Ice
5. Freezing
6. Zero

Answer Sheet to Test
on
MECHANICAL REFRIGERATION SYSTEMS

1. True
2. True
3. True
4. False
5. False
6. True
7. True
8. True

Answer Sheet to Test
on
MAINTENANCE OF REFRIGERATION SYSTEMS

1. False
2. True
3. True
4. False
5. False
6. False
7. True
8. True

Answer Sheet to Test
on
PRODUCT LOSSES AND RECORDS

1. True
2. True
3. False
4. False
5. True
6. True
7. True
8. False
9. False
10. True

Answer Sheet to Test
on
OPERATING EFFICIENCIES AND PRODUCTION SCHEDULES

1. Think
2. Costs
3. Efficiency
4. Working
5. Filling
6. Switches
7. Order
8. Shut-off
9. Cut off
10. Neat

Answer Sheet to Test
on
CONTAINER LOSSES

1. True
2. True
3. False
4. True
5. False
6. False
7. False
8. True
9. True
10. False

Answer Sheet to Test
on
WASTE PREVENTION

1. False
2. False
3. True
4. True
5. True
6. True
7. True
8. False
9. False
10. False

Answer Sheet to Test
on
WASTE DISPOSAL

1. True
2. True
3. False
4. True
5. False
6. True
7. True
8. True
9. True
10. True

Answer Sheet to Test
on
PAINTING

1. True
2. True
3. True
4. False
5. False
6. True
7. False
8. True

Answer Sheet to Test
on
FLOOR, ROOF, AND WALLS

1. False
2. False
3. False
4. False
5. True
6. True
7. False
8. True

Answer Sheet to Test
on
LIGHTING, VENTILATION, AND AIR CONDITIONING

1. True
2. False
3. True
4. False
5. True
6. True
7. False
8. True
9. True
10. False

Answer Sheet to Test
on
LUBRICATION

1. Yes
2. Yes
3. Yes
4. Yes
5. No
6. No
7. No
8. Yes
9. No
10. Yes